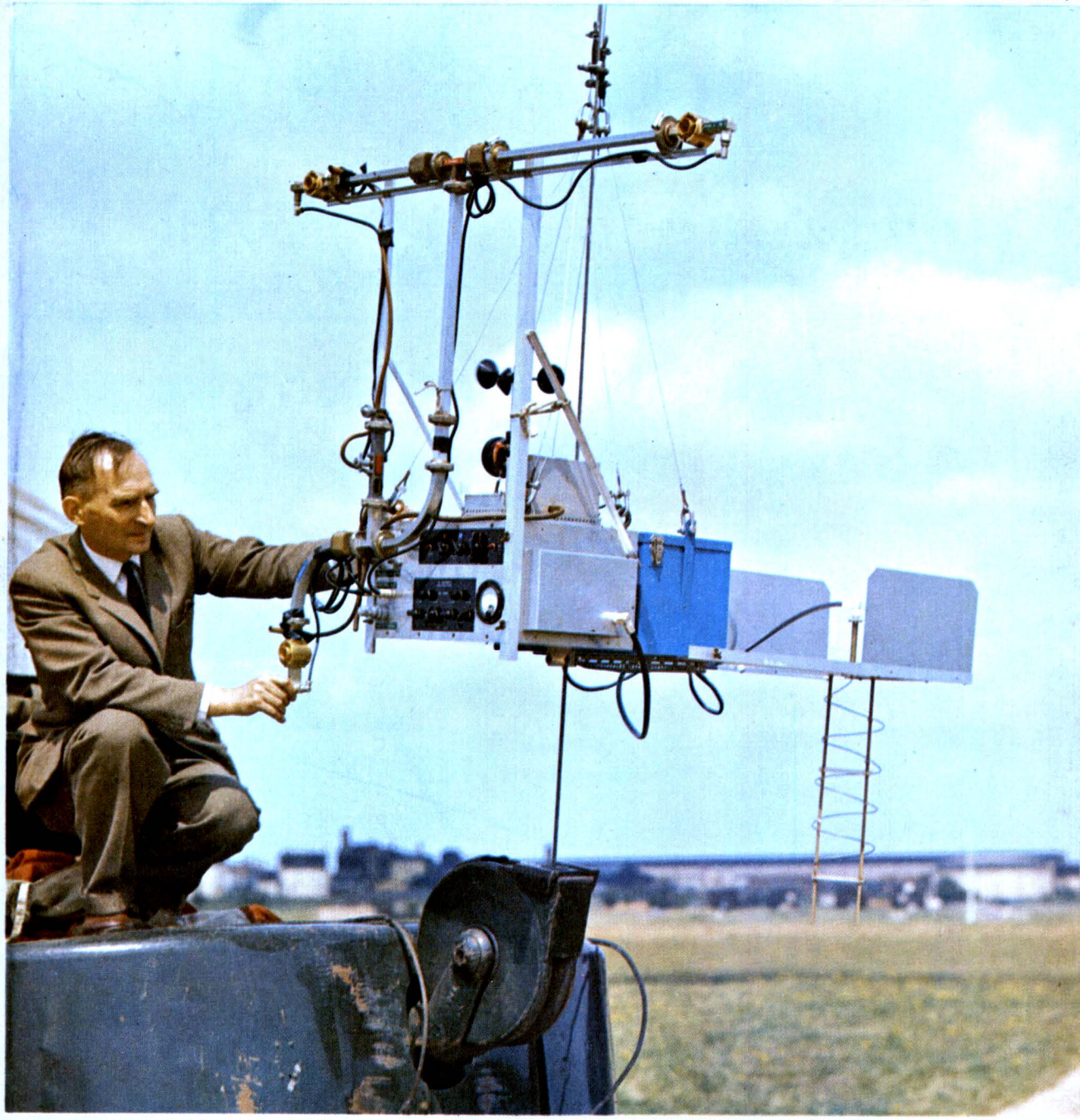
ELECTRONICS Australia

September, 1968

Incorporating RADIO, TELEVISION & HOBBIES

Vol. 30 No. 6



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30c

History of the "talkies" • New A-F generator

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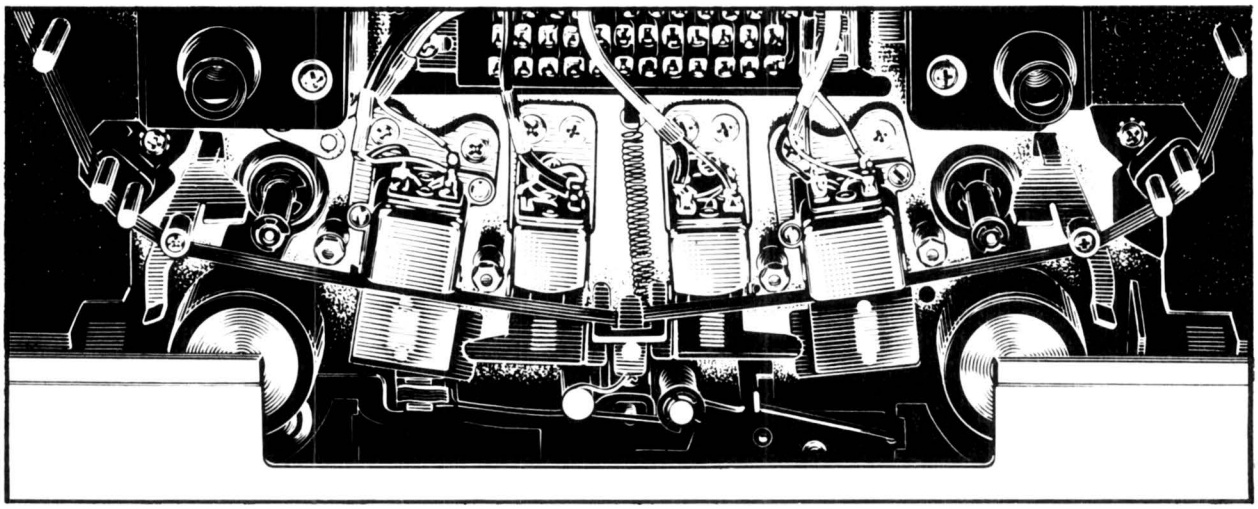

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Incorporating "RADIO, TELEVISION and HOBBIES"

ABC certified circulation in excess of 47,000.

Volume 30, No. 6

Man or machine?

With so much accounting now being handled by computers, we are hearing rather too frequently such phrases as: "It must be right; computers don't make mistakes." Or conversely: "Sorry, we can't do much about it; our accounts are handled by a computer."

In Britain, a society has been formed calling itself the "International Society For The Abolition of Data Processing Machines." Its members are allegedly being encouraged to defeat data processing equipment by demagnetising magnetically coded cheques and making extra holes in punched cards. While this may cause the participants to be branded as anything between crusaders and "nuts," it does raise the question as to whether the line between protest and fraud is any different for documents magnetically or punch-coded and those which carry their information in typed or handwritten form.

Be that as it may, the kind of remark I referred to earlier is symptomatic of an attitude to electronic data processing, which can be evident all the way from management to the office boy. The computer is accorded the role of a monster, inaccessible to all but its white-frocked attendants, inflexible, unsympathetic, given to sending out repetitious demands to deceased defaulters and, above all, providing a ready-made excuse for not giving matters individual attention.

And this much is true: A room full of EDP equipment, rigidly programmed and operated without reference to staff or customers, can be — and in fact is — a very inhuman installation. But should we blame the machine or the man?

If reactions like those above are to be minimised, close study must be given to the question of access to the EDP system so that employees in contact with the public can inject revelant short-term information, just as they once could do with the traditional accounting department. With this facility and proper staff and customer education, there would be less to provoke the "I hate computers" reaction.

I personally might have had less trouble in convincing a local utility that there was nothing wrong with the meter and that the account which their computer refused to issue was quite in order. We had simply been overseas for most of the quarter . . . most of the quarter . . . most of the quarter . . .

W. N. Williams

September, 1968

COVER PICTURE: With the aid of equipment suspended from a captive balloon or a helicopter, the refractive index of the atmosphere is being studied by workers at the Radio and Space Research Station of the Science Research Council, Slough, England. See also page 21.

NEW INSTROL HI-FI EQUIPMENT

INSTROL Model T-101
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WIDE BAND TUNER

A high quality hi-fi tuner designed to operate in conjunction with all makes of amplifiers.

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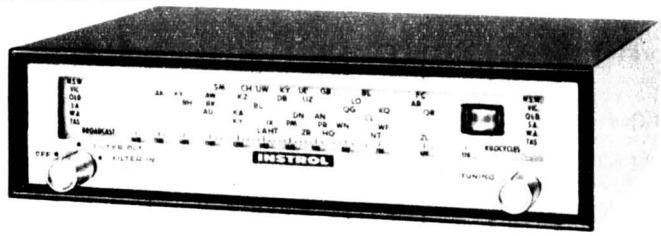

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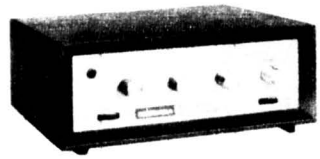

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T101 TUNER (in metal case)	$72
20-20 AMP' (in teak case)	$99
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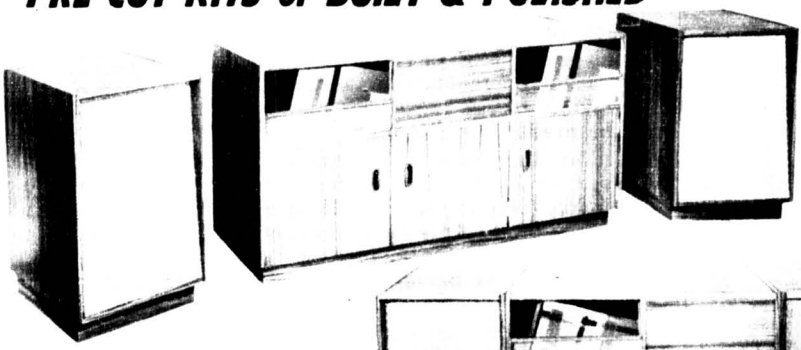

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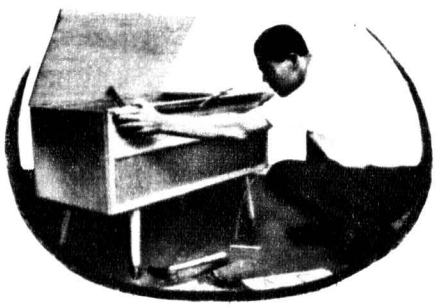

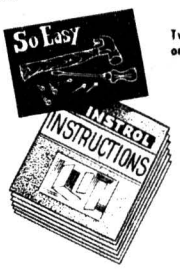

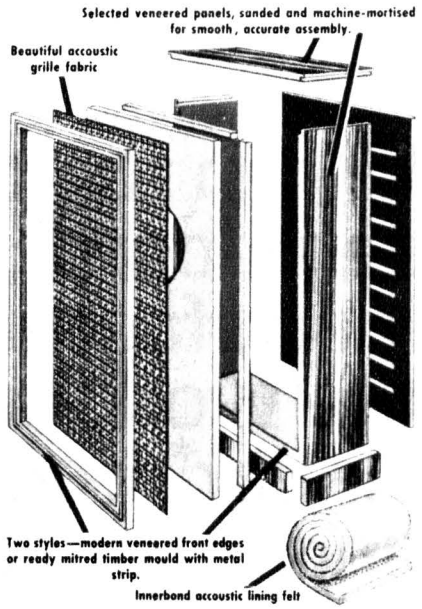

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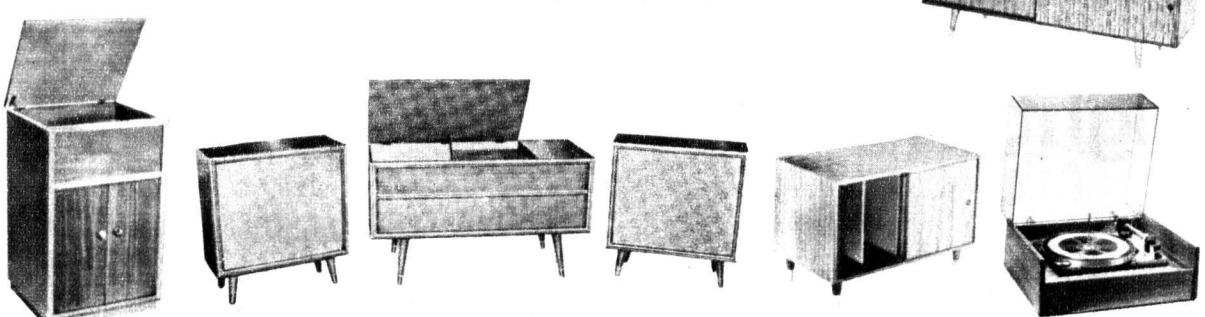

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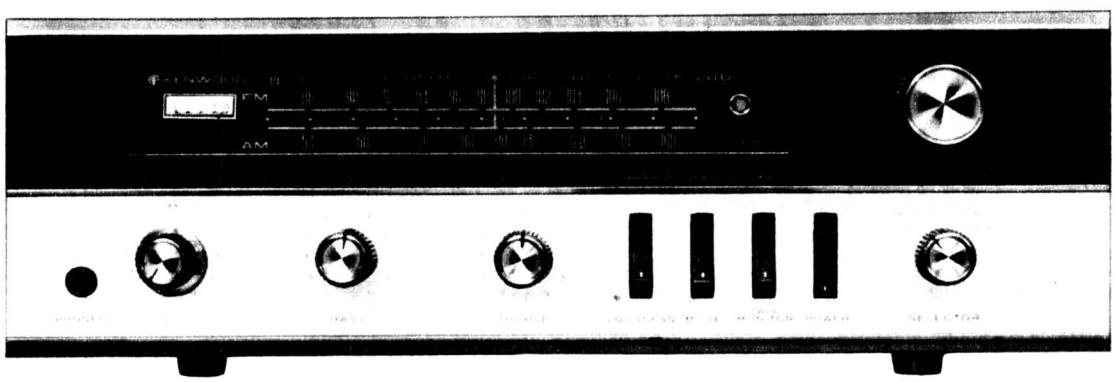

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The TK-20U Solid State Stereo receiver powered by Silicon Transistors is reasonably priced (Aust. $219). It performs equally as well as the more expensive models. The features include 30 watts of total music power, (F.E.T. Field Effect Transistor) 3 gang tunging condenser, 5 IF Stages and a magnificent bass and clean treble sound. For greater power, other amplifiers are readily available.

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*F.E.T. (Field Effect Transistor) 3 Gang Tuning Condenser frontend for superior sensitivity, image rejection and cross modulation ratio.
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*USABLE SENSITIVITY:
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AM: 10 microvolts (IHF Standard)
*TOTAL MUSIC POWER:
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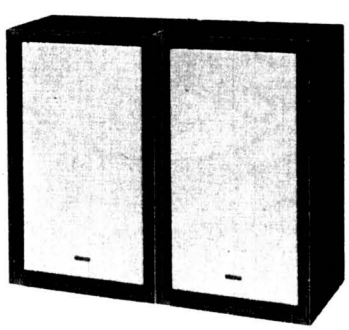
30 watts (IHF Standard at 8 ohms)
*FREQUENCY RESPONSE: 25Hz—40,000Hz
*DIMENSIONS: 14 1/16"(W), 4 3/4"(H), 11 1/4"(D)



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*60 watts input, 5-speaker, 4-way system
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*Four-step tone selection
*Completely sealed enclosure
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6½ inch cone squawker×1 (lower midrange)
4 inch cone squawker×1 (higher midrange)
Horn-type tweeter×2 (Trebie)
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*Dimensions: 15"(W), 25½"(H), 11⅝"(D)

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40 WATTS SOLID STATE STEREO AMPLIFIER TK-150U

▼ TK-150U
*40 watts of IHF Standard total music power
*All transistor amplifier provides wide 20 to 50,000 Hz frequency response and 20 to 60,000 Hz power bandwidth.
*5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
*Damping factor: 40 (at 16 ohms), 20 (at 8 ohms)
*Dimensions: 10¼"(W), 4⅛"(H), 9⅜(D).

60 WATTS SOLID STATE STEREO AMPLIFIER TK-250U

▼ TK-250U
*60 watts of IHF Standard total music power
*Very low IM distortion for exceptional clear sound low level to high level listening
*High damping factor 23 (8 ohms), 46 (16 ohms) for excellent transient response
*2 sets of stereo speaker terminal and front panel speaker selector switch.
*Frequency response: 20Hz—50,000Hz (±1dB)
*Power bandwidth: 18 Hz—60,000Hz (−3 dB)
*Dimensions: 13"(W), 4⅛"(H), 9⅝"(D).

90 WATTS SOLID STATE STEREO AMPLIFIER TK-400T

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▼ TK-400T
*90 watts of IHF Standard total music power to drive even low efficiency HI-FI speakers.
*Blow out free exclusive automatic circuit breaker protects power transistors (U.S. Pat.)
*NF type tone control.
*Frequency Response: 20 Hz - 50,000 Hz (±1dB)
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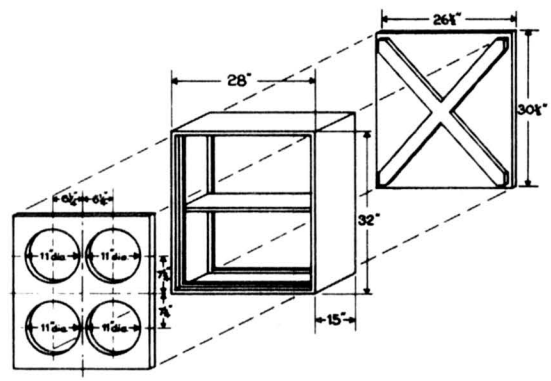
SPECIFICATION

TYPE NUMBER	50226/12PQ/15 PRESTIGE FINISH	21622/12PQ/15 MANUFACTURERS TYPE	53416/12PQ/8 MANUFACTURERS TYPE
Impedance	15 ohms	15 ohms	8 ohms
Frequency Range	35-6000 Hzs	35-6000 Hzs	35-6000 Hzs
Resonance	40 Hz	40 Hz	40 Hz
Maximum Power Handling	15 W	15 W	15 W
Magnet Material	Alnico V	Alnico V	Alnico V
Flux Density	10500 gauss	10500 gauss	10500 gauss
Total Flux	82000 lines	82000 lines	82000 lines
V.C. Diameter	1¾″	1¾″	1¾″
Mounting Hole Centres	11¾″ P.C.D.	11¾″ P.C.D.	11¾″ P.C.D.
Maximum Depth	6¾″	6¼″	6¼″



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. . . Part One

and the lampblack-coated paper with a photographic plate. it showed that photography could be used to make a permanent recording of sounds. What remained was for someone to show how it might be possible to reproduce sounds from a recording of this type.

Surprisingly enough the ultimate answer to this problem was found within only two years, although it was to be many years more before this fact would be acknowledged. Again it was two American pioneers who figured prominently in the new developments: Alexander Graham Bell, who had invented the telephone in 1876, and an imaginative theorist named Charles E. Fritts.

In 1879 A. G. Bell and a group of co-workers conducted experiments with a light-sensitive cell using the metal selenium. Although this metal had been discovered as early as 1817 by J. J. Berzelius, it had not been until 1873 that the English telegraph engineer Willoughby Smith had discovered that it exhibited a sensitivity to light.

Using Smith's discovery that the electrical resistance of selenium varied according to the light falling upon it, the Bell group late in 1879 succeeded in sending a telephone message over a modulated light beam. The beam was modulated at the transmitting end using a vibrating mirror similar to that used by Blake, while at the receiving end a selenium cell connected in series with a battery and telephone receiver converted the light variations first into current variations and then back into corresponding sound waves.

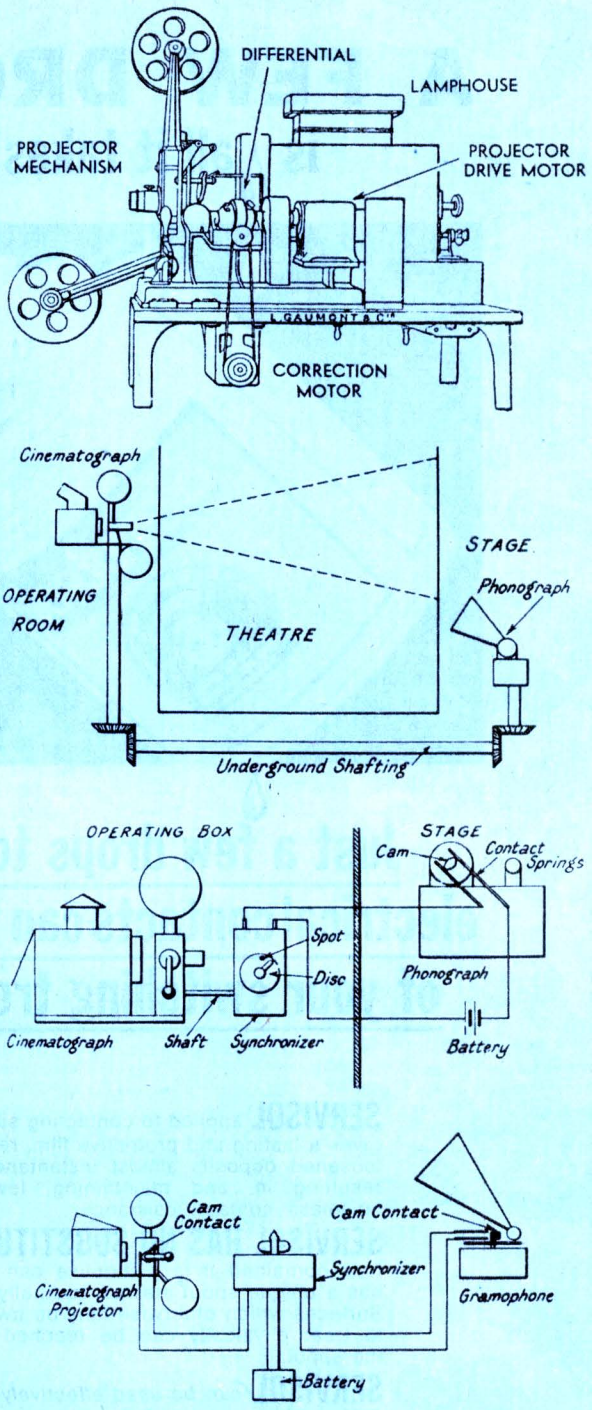
In 1880 Bell patented this method, which he envisaged as a possible means of providing a "wireless" telephone system — a prediction which has already proved partially true, and which may ultimately prove more accurate in essence than Bell could ever have foreseen. However, quite apart from its implications for telephony, Bell's discovery showed that it was quite possible to transform sounds into light variations and then back again.

The final step in this discovery of basic principles was to interpose the photographic process between the sound-light and light-sound transformations, and this step was taken in the same year by Charles Fritts. Late in 1880 Fritts filed a U.S. patent application entitled "Recording and Reproduction of Pulsations or Variations in Sounds and other Phenomena".

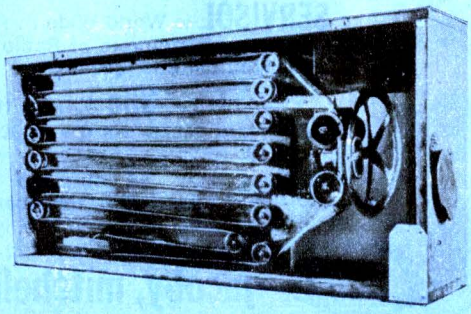
As one historian has observed, Fritts' patent application was remarkable for three reasons. It was very complete, and also of broad scope, involving some 96 individual claims and occupying 29 pages; however, even more remarkable was the fact that it languished in the patent office for no less than 36 years, to be granted finally on October 31, 1916!

It would appear that Fritts was mainly a theorist. However, a number of sources report that in 1880 he succeeded in recording sounds photographically upon a paper strip, and subsequently replaying them by means of a selenium cell.

In the ensuing six years considerable work was done by Alexander Bell and his co-workers C. A. Bell and S. Tainter. In 1886 this trio was granted a most comprehensive and detailed patent covering both the recording and reproduction of sounds using photographic medium. The patent disclosed that during recording a narrow slit of light was moved transversely relative to the photo-sensitive surface, the light being modulated by the sound signals either in terms of effective slit length or overall brightness. Repro-



Early systems used to provide sound from gramophone discs. At the top is Gaumont's "Chronophone," then a "long shaft" system, a worm-ratchet system, and the "Vivaphone."



The first "Kinetoscope," which was completed in Thomas Edison's laboratory around 1890.

duction was performed using a similar but constant-intensity slit of light focused on the developed record, with a selenium cell to detect the photographic density modulations. The patent discusses both physical and optical methods of providing the necessary slits of light.

Without a doubt the 1886 Bell patent covered most of the basic principles which were ultimately to make commercial sound motion pictures a reality. It gave not only the broad outlines of the basic sound-photography-sound process, but also showed considerable insight into such technicalities as the advantage of slit scanning, the alternative possibilities of variable-slit-width and variable-slit-brightness recording (later to become known as the "variable area" and "variable density" approaches, respectively), and the methods available for production of the scanning slits.

At this stage it may be worthwhile to digress briefly and explain for the benefit of the uninitiated reader the importance of "slit scanning".

The idea is a fairly basic one. In order to record a sound of a particular frequency or pitch, the photographic film must move significantly relative to the recording light spot, during the time taken for a single complete cycle of the sound wave — otherwise, the brightness or width modulations of the spot will be superimposed upon one one another and will mutually cancel. In fact it transpires that, at the very least, the film must move past the spot during the sound cycle by a distance equal to the length of the spot in the direction of film motion.

As the frequency of the sounds which one desires to record is raised, the shorter becomes the time in which the film must move past the recording spot by the effective spot length. Therefore in order to permit recording of as many as possible of the component frequencies of naturally occurring sounds, the effective film (scanning) speed in "spot-lengths per second" must be as high as possible.

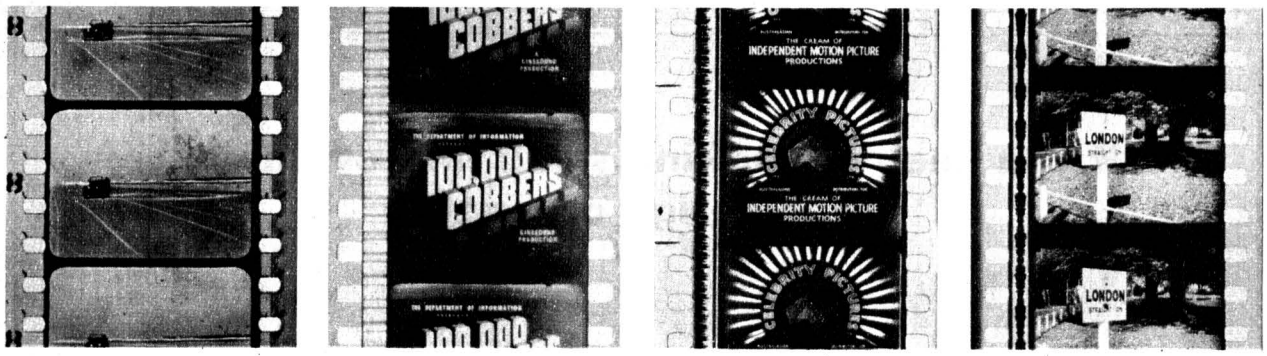
The actual speed of motion-picture film is determined largely by economic and technical considerations associated with the picture recording, and is therefore more or less fixed. Hence the only way to increase the effective sound scanning speed is to make the recording spot as short as possible in the direction of motion.

The effective spot width need not be reduced correspondingly, however. Indeed, in order to maintain a reasonable optical efficiency and also to permit linear modulation with the variable-width or "variable area" method of recording, the available width should be as large as practicable. Hence the logical shape of the recording light spot is a slit, with its smaller dimension aligned with the direction of film travel.

Similar requirements dictate that the light spot used for reproduction of the recordings have a similar shape, with an effective scanning length preferably even narrower than that used for recording.

It was in the 1880s that the motion picture itself became a reality, evolving both from the growing art of photography and from the accumulating insight into persistence of vision.

As early as 1853 an Austrian artillery officer named Baron Franz von



The various common methods of photographic sound recording, as shown by four film clips. At far left is the original silent film format, for comparison, then follow (l. to r.) sound films having variable-density recording, "unilateral" variable-width or variable-area recording, and finally "bilateral" variable-width recording.

Uchatius had succeeded in projecting animated drawings upon a screen using a modified "magic lantern," while in 1878 the rather eccentric English inventor Eadweard Muybridge (sic!) had succeeded in California in making a series of "time snapshots" of animals and men in motion. Inspired by Muybridge, the French physiologist Jules Marey invented in 1882 two different types of motion-picture camera; with one, a "photographic gun" developed from previous work by the French astronomer, Janssen, he succeeded in taking motion pictures of birds in flight.

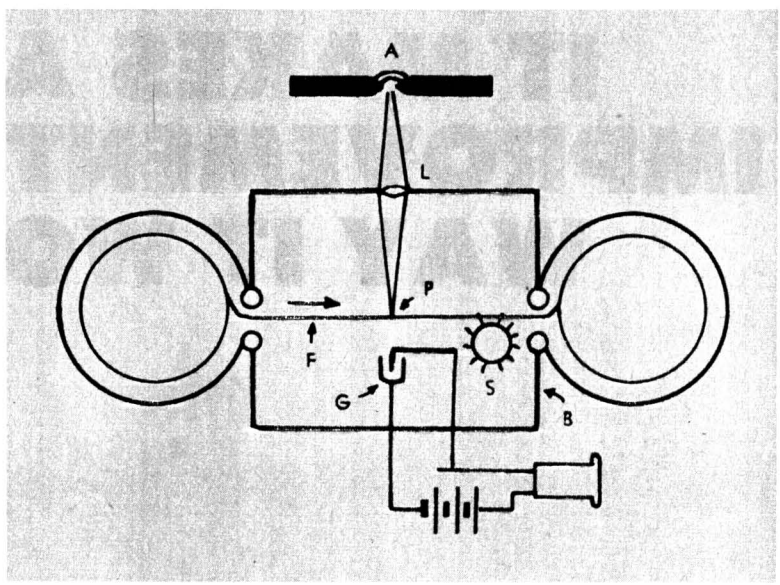
In the late 1880s practical motion picture cameras and projectors were developed by a number of inventors. In France the development came from Marey and a man named Louis Le Prince; in England, from William Friese-Greene; and in America, from William K. L. Dickson working in Thomas Edison's laboratory in West Orange.

Considerable confusion exists regarding the development of motion pictures in the Edison laboratories in the late 1880s. However, it would appear that Dickson first produced a practical camera toward the end of 1889, and a peep-hole viewer in early 1890. Edison promoted the latter device widely in the early 1890s as a carnival and "penny arcade" novelty, giving it the name "Kinetoscope."

From the moment the kinetoscope appeared Edison sought to combine it with his phonograph. In 1894 he announced a modified version, the "Kinetograph," in which ear-tubes allowed the viewer to listen to a recorded accompaniment. It was very crude and met with little success, but Edison would not admit defeat. He either ignored or was ignorant of the work of Fritts and Alexander Bell, and he and Dickson doggedly pursued the aim of producing talking pictures by means of the Phonograph.

It is true that Edison was not alone in taking this course; there were many others with a similar faith in either the phonograph, or its rival the gramophone which had been invented in 1887 by Emil Berliner. In France, Charles Pathe and Oskar Messter tried with little success to combine motion pictures with the gramophone in 1896, while in 1900 three other French inventors gave an exhibition of sound films at the Paris Exposition. In the same year an enterprising Frenchman named Clemente Maurice even opened a cinema in Paris devoted entirely to sound films, calling it the "Phono-Cinema-Theatre."

In actual fact, the efforts of inventors to couple either the phonograph or the gramophone together with motion



A sketch of the apparatus used by Professor Ruhmer around 1901 to record sound and electrical waveforms. At A is an arc or discharge lamp whose current was modulated with the recording signals; the light from A was focused on the film F by lens L. After processing, the recording could be reproduced by means of a selenium cell G, using a steady illumination from A. The film speed used was about 10ft/second.

pictures continued well into this century. There were two basic problems: the difficulty in synchronising picture and sound, and the difficulty in obtaining sufficient sound volume for a theatre auditorium. The latter problem was eventually solved with the invention of the thermionic triode valve and its application as an amplifier, but the synchronisation problem was never to be solved really satisfactorily.

Edison himself persisted until 1913, when he brought out his "Kinetophone"(!). This was an intriguing apparatus in which a long drive belt ran from a phonograph behind the screen all the way back to the picture projector in the rear booth or "bio-box." The Kinetophone had a commercial run for about 16 weeks in the B. F. Keith theatre in New York before being mercifully lost in oblivion.

Earlier, in 1908, Edison had brought out another phonograph synchronising system, called variously the "Camera-phone" and the "Cinephone." In this system the sound was recorded first, then replayed while the picture was photographed. A small pointer and dial on the phonograph was photographed in one corner of the picture, so that in the theatre the projector operator could vary his speed to make the projected dial pointer correspond with a similar dial and pointer on the reproducer at the front of the theatre. Not surprisingly, this system had novelty value only and was soon discarded.

At about the same time, many inventors were trying similar systems with a similar lack of success. In England the Hepworth Manufacturing Company Limited around 1909 promoted a system which they called the "Vivaphone." This consisted of an indicator box in which a balanced armature was pulled in opposite directions by two electromagnets supplied respectively with current pulses from commutators coupled to the projector and gramophone.

When the two machines were operating at the appropriate relative speeds for synchronism, the forces exerted on

the armature by the two electromagnets balanced out, and the pointer remained vertical. However, an increase or reduction in the relative speeds caused an imbalance, and the armature tilted in one direction or the other to uncover a red or green indicator lamp. The operator then had to increase or decrease the projector speed to restore the status quo.

As it was only a relative speed measuring device the Vivaphone could hardly ensure exact and reliable synchronism; in any case it was up to the operator himself to make the necessary corrections indicated by the device, and the "human factor" introduced considerable error. Nevertheless a number of films were apparently released for the system, including one of Goethe's "Faust."

In December, 1910, the French pioneer Leon Gaumont demonstrated to the French Academy of Sciences his "Chronophone," a system which was hailed as eminently successful. From the records describing this system it would appear to have employed a crude servomechanism, in which the armatures of the projector and gramophone drive motors were coupled electrically and a small "correction motor" used to alter the speed of the projector by means of a differential gearing system.

Although still only a device for maintaining the relative speeds of the gramophone and projector constant, Gaumont's system apparently succeeded in removing the human element. It was used with some considerable success for some years both in France and America, but eventually faded away when audiences tired of the novelty and came to demand more realism from sound pictures than it could provide.

It might seem from the foregoing that the invention of the phonograph had succeeded in side-tracking all research away from the more promising photographic sound system, but this was not the case. Research was still continuing into the latter system, not only among those specially seeking a practical sound system for motion pictures, but also among those whose main concern was simply the attainment of a greater degree of knowledge about sound and sound recording.

In passing it should also be noted that the advent of the phonograph and gramophone had not stopped the search for alternative sound recording systems, either. In 1901 the Danish engineer Valdemar Poulsen filed a patent describing a method of recording sounds magnetically on a steel wire. Poulsen's "Telegraphone" thus became the ancestor of modern tape recorders and the magnetic sound system used for many modern "prestige" films, as we shall see later in this survey.

One of the problems encountered by the Bell group in their efforts to perfect a photographic sound recording system was that the light-sensitive selenium cell which was used for reproduction had a poor frequency response and tended to give the reproduced sounds a "muffled" character. The answer to this problem was found in 1900 by an experimenter named J. Poliakoff, who filed a patent for a method of photographic sound reproduction using not a selenium photoconductive cell, but rather a gaseous photo-emissive cell.

The existence of the phenomenon of photo-emission had been noted by the scientist Heinrich Hertz as early as 1887, while in 1889 J. Elster and H. Geitel produced a gaseous light-sensitive cell based upon photo-emission. However, the output of early photo-emissive cells was extremely low, and it would appear that little attention was given the new device until Poliakoff found not only that it was capable of performing in place of the selenium cell in a photographic sound reproducer, but also that it was capable of better response. As it transpired, this discovery was to remain largely unrecognised for some years.

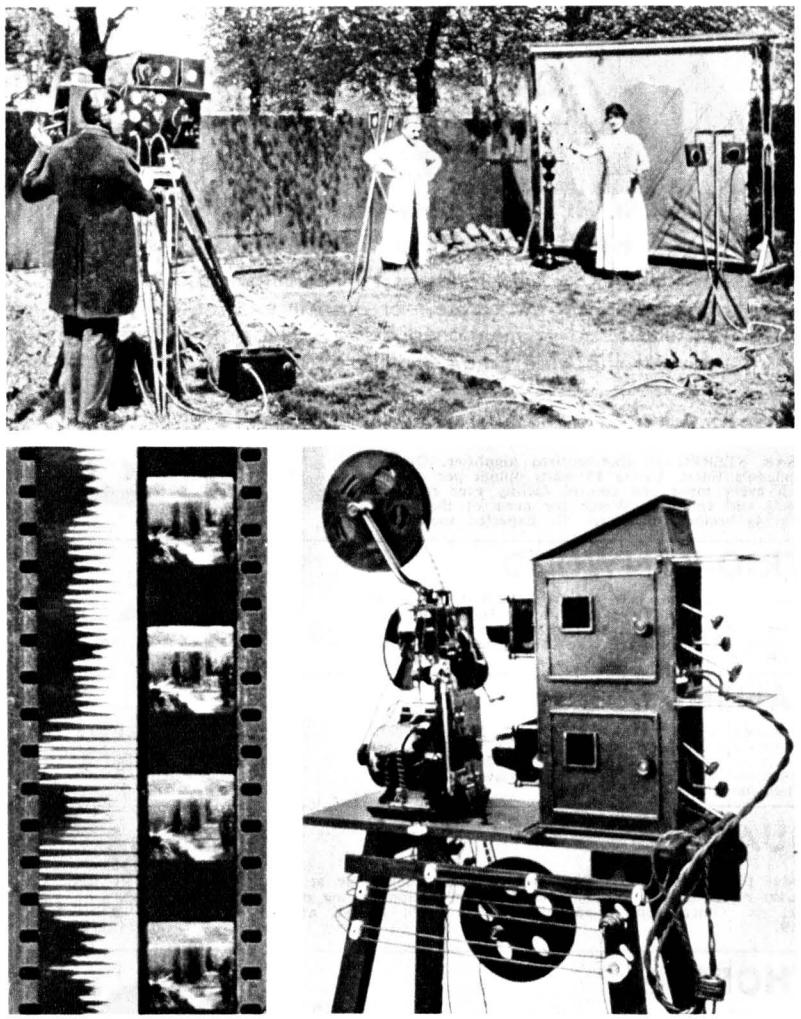
In 1901 Professor Ernst Ruhmer began publishing reports of a series of experiments on photographic sound recording which he had performed. Ruhmer was an academic, and his work was directed not toward a system of providing sound for motion pictures but rather towards the analysis of sounds and electrical waveforms; however he was not unaware that his work might have commercial applications.

Ruhmer made photographic records of electrical and sound waveforms using both arc lamps and gas discharge lamps as the source of modulated light. He recorded on the full interperforation width of 35mm motion picture film, and used scanning speeds of about 10ft/second; reproduction was by means of a selenium cell. Ruhmer called his apparatus the "photographophon."

In November 1902 William Duddell filed a patent titled "An Improved Phonograph," in which he described a method of variable width photographic recording using a special d'Arsonval mirror galvanometer as the means of modulating the recording light beam. Duddell also envisaged the use of photographic printing to produce multiple copies of a master recording.

Four years later, in 1906, a patent was filed by a group which included Eugene A. Lauste, a French inventor who had originally been an employee of Edison. Although the patent was very comprehensive — its title was "A Method and Means for Simultaneously Recording and Reproducing Movements and Sounds" — it apparently gave little if any specific information regarding any significant developments from the original work of Bell, Poliakoff or Ruhmer. However, if nothing else, it identified Lauste as a serious worker in the field.

In the years following Lauste spent considerable effort in refining and developing the practical aspects of a motion picture sound system, and it seems undeniable that while he may



Eugene A. Lauste's experimental sound-on-film system of around 1918, in which pictures and sound were recorded side-by-side on standard 35mm film—possibly for the first time. At the top is the camera in use with Lauste himself (white coat) looking on; below are a sample of the film, and the projector used for reproduction.

not have been responsible for any fundamental discoveries involved, he certainly contributed greatly to their development into a practical system. Over the years 1906-1919 he progressed from experiments with a crude "vibrating grid" recording modulator to a stage where he had a practical working sound camera and projector system.

Lauste experimented with a variety of sound recording methods, at first directing his attention to variable-density recording and then changing to variable-width. Illustrated are his camera and projector of around 1918, which were apparently capable of quite impressive performance at that time.

The camera employed a "string galvanometer" light modulator, with an arc lamp as the source of light. The galvanometer was in fact almost identical with the "light valve" to be later used by Western Electric, although Lauste used it for variable-width rather than variable-density recording.

Perhaps surprisingly Lauste was still using a selenium cell for reproduction, because the only means of amplification at his disposal was the "telephone amplifier." This consisted of a magnetic telephone receiver/carbon microphone combination sharing a common diaphragm. The receiver was connected in series with a battery and the selenium cell, while the carbon microphone produced an amplified version of the fluctuating selenium cell current in a similar series circuit consisting of a loud-speaking telephone receiver and a second battery.

The reason why Lauste had no more refined means of providing signal amplification was that the triode thermionic valve, although invented around 1906, had not as yet been made generally available for this purpose. Amplifiers had been produced, but mainly in the research laboratory, and apparently Lauste was unable to obtain such an amplifier if indeed he was even aware of its existence.

Because of the resultant need to obtain maximum signal from the reproducing cell, he was forced to employ a wide sound track which occupied half the inter-performation width of 35mm film. In addition he used in the projector a second arc lamp which was used purely to provide sufficient light for efficient scanning.

Although the film sample shown reveals only "unilateral" or single-sided variable-width recording, Lauste apparently realised by 1918 that bilateral or double-edged recording (see film clips) would give greater utilisation of the selenium cell area and hence greater reproduction efficiency.

Lauste was of course not the only inventor to work on the problems of motion picture sound between 1906 and 1919; there were a number of others, including three men who were to play important roles in the ultimate realisation of a fully commercial sound film system. The three men were Dr Lee De Forest, Theodore W. Case and Earl I. Sponable.

The work of these men will be discussed in the second article of this survey. Also discussed will be the brief final appearance of the sound-on-disc system in the form of "Vitaphone" — whose first few films may justly be said to have triggered the sound revolution.

(To be continued).

SOLID-STATE TELECINE

with true colour balance

Experience gained in colour television in U.S.A., Britain and elsewhere shows an unfavourable audience reaction to successive programs and commercials with noticeable differences in colour balance. Equipment designed to overcome this problem was demonstrated recently in Sydney and Melbourne.

by Harry Tyrer

Rank Cintel's marketing manager Neil Burtonshaw explains features of the flying spot film scanner at the AWA works, North Ryde, N.S.W.

The equipment is part of a range of Rank Cintel colour television equipments displayed for the benefit of the television industry and other interested parties, by AWA. Although no date has yet been announced for the inauguration of colour television in Australia, interest is high among station technical staff. Overseas manufacturers of colour equipment are actively promoting their products, and the recent demonstrations of the Rank Cintel equipment has resulted in some stations ordering units of the type demonstrated.

With colour television, as with black and white, Australia will be coming late into the field, and as a result will benefit from the tremendous effort going on overseas to overcome problems such as that mentioned above. Marked changes in colour balance have been proved to be a source of irritation to viewers, as each change requires a mental adjustment to the new conditions. The Rank Cintel equipment displayed by AWA incorporates features which can spare Australians such minor irritations.

The major item of equipment at the AWA demonstrations was the Rank Cintel 16mm twin lens flying spot film scanner. This is an all-solid-state version of the unit originally introduced by Rank Cintel in 1964. The big advantage of the flying spot method of colour analysis used in this unit is that problems of misregistration are virtually non-existent.

This latest version of the unit, besides being solid state, has been provided with a number of facilities designed to cope with problems experienced by TV stations in presentation of colour programs. These facilities include colour masking, remote operation and various types of automatic control.

Colour masking is a term borrowed from the printing industry and implies a means of correcting colour errors in the original material, during the process of preparing printing blocks or plates. These errors mainly arise from the unavoidably broad spectral response characteristics of the film dyes, since it is impossible to obtain dyes of complete spectral purity. The amount of spectral error varies in the different brands of colour film.

In the printing industry, masking is done literally, by making a faint separation positive, and placing this in registration with the separation negative during the making of the block or plate to be used for printing that particular colour. Electronic masking in television practice is carried out by modifying the acceptance characteristics of the channel to be masked. In the Rank Cintel film scanner, correction for up to seven different types of colour film can be selected from preset controls.

Whereas colour masking compensates for the fixed differences in colour balance of film stocks, it cannot cope with colour faults arising from processing errors. These errors may arise from faulty exposure; the colour temperature of the light source used in the original exposure; the colour temperature of the light source used in the duplication process; failure to compensate for the colour temperature when making 16mm copies from 35mm stock balanced for arc projection; dye tracking errors in film development.

Equipment designed to deal with these problems was displayed at the AWA demonstrations. The unit, known as TARIF, was developed by engineers of the British Broadcasting Commission and is made under licence by Rank Cintel. The film scanner referred to above has provision for incorporating TARIF as an integral unit, or as an add-on accessory.

Basically, correction is made by adjusting the colour balance in the highlights and shadows; or putting it another way, changing the contrast (gamma) law at the high or low end, the range of control being from "black crush" (compression) to "black stretch" (expansion). A separate calibrated control is provided for each channel so that the corrections may be applied to any one or any two of the video signals in varying degrees, thus allowing correction on any of the colour axes. (The axes are 24 equally spaced angles of Maxwell's colour triangle.)

TARIF also has provision for limited adjustment of overall brightness and black level settings. Two calibrated controls, marked "Master Gain" and "Master Lift," apply equal adjustments to all three colour channels simultaneously. Another feature of TARIF is a systems check facility which allows the corrective effects of the system, compared with the original picture, to be observed by switching the correction circuits in and out of operation.

Major advantages of TARIF from the production point of view is that the colour balance adjustment controls are calibrated, and the unit may be remotely located from the film scanner. These features allow the settings for balancing any particular piece of film or slide to be recorded, so that setting the controls for a repeat run entails merely choosing the same settings; and TARIF can be directly under the control of the program production personnel.

This last point means that all film and slide sources may be balanced each to the other and to studio cameras, at one central point, under controlled conditions and using a common monitor.

Other points of interest in the film scanner are the patented constant velocity twin-claw film transport mechanism; and the twin-lens optical system.

The first development provides extremely stable pictures by eliminating jerkiness in the film transport. The first claw pulls the frame down through the gate, and as it reaches the end of its travel, the second claw is already engaged and starting to pull the next frame down. The overlap is such that film shrinkage errors are automatically corrected.

In the twin lens optical system, each frame is scanned twice, firstly through an upper path and secondly through a lower path. The two images are then combined to form the interlaced picture. ■

Low-cost satellite launchings possible with

BRITAIN'S ION-THRUST ROCKET MOTOR

The enormous cost of putting satellites in orbit by the usual method, using multi-stage rockets, has inhibited activities in this direction in Europe. An alternative method, using a small and relatively cheap rocket to put a satellite into a low orbit, then pushing it further out by using the thrust of a beam of ions is now under investigation in Britain. The author describes an ion beam thruster developed by Elliott-Automation Ltd.

By Dr. P. R. Obenshaw*

Space propulsion is achieved by the directed ejection of mass which imparts an acceleration to a space vehicle. This can be produced either by increasing the propellant temperature, and hence pressure, in a confined volume, as in a chemical rocket, or by the direct application of forces produced by electric and magnetic fields acting upon the propellant in an ionized state. Most electrical propulsion devices fall into this latter category.

Within this category, there is a natural division into two main classes — the ion thruster and the plasma thruster. In the former, ions are produced either by surface contact ionization or by electron bombardment, and then accelerated in a strong electric field to the desired velocity. In the latter the thruster accelerates a plasma, consisting of positive ions, neutral atoms or molecules, and electrons directly as a composite mass, rather than only one of its constituents.

This is achieved by applying a force to the electrically neutral, but conducting, plasma, by means of the interaction between electric currents in the plasma and self-induced or externally applied magnetic fields. The plasma is usually initially produced by passing an electric discharge through a vapour of the required fuel.

Unlike chemical rockets, where an exothermic reaction between propellants provides sufficient energy for their ejection, the electric thruster requires a separate power supply. The most likely source of power for space vehicles of the present and near future is solar cells. More advanced energy sources such as fission or fusion devices are being studied or developed, but in general they should be regarded as not being available for the present generation of launcher.

In practice, the additional weight required for the power supply system of the electric propulsion unit has to be considered. This, in a properly designed system, will be approximately equal to the fuel weight. In this case, the weight of the two major items in an electric propulsion system is still considerably less than that for conventional chemical rockets. It can be shown that advanced and very distant missions are not practical unless exhaust velocities similar to those produced by electric propulsion are used, since only then is the ratio of payload to fuel mass reasonable.

Electric thrusters, while producing very much less acceleration than chemical rockets, can maintain constant thrust over a very long period of time compared to a conventional rocket. For a long voyage, such as to a planet, an electric propulsion unit would arrive sooner than a similar chemical one or, conversely, would be able to carry a greater payload in the same time. For a comparatively short trip, like the orbit transfer manoeuvre to be discussed, the slowness of the trip — a few months to a year — is potentially acceptable because of the overall economic advantage of this method.

There are great advantages for the use of electric thrusters for satellite placement by orbit expansion. In this type of manoeuvre, a satellite is established in a low orbit with a conventional rocket, and then over a period of a few months, the orbit is expanded to that required.

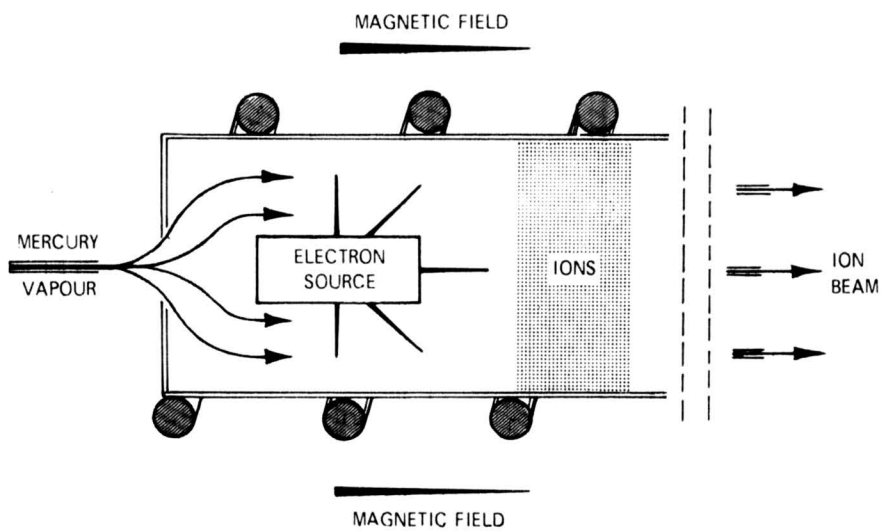
This is usually a synchronous orbit for communication satellites, so that at a height of 24,840 miles and in an equatorial plane the satellite appears stationary with respect to a point on the earth's surface. Besides an expansion of the orbit, it is also possible to change the inclination of the orbital plane; as however this additional manoeuvre requires extra energy and reduces the payload in final orbit, it is undesirable.

Satellite raising by electric propulsion is particularly attractive to Britain as it provides a means of establishing synchronous communication satellites without the need for large multi-stage chemical rockets and it thus saves the vast cost of such a development.

The plan is that a comparatively cheap Black Arrow rocket could establish a satellite in a low orbit approximately 186 miles height, and that over a period of several months an electric thruster could expand the orbit height and also change the inclination of the orbit plane, if required, to that of a synchronous satellite.

Consideration of the payload and cost compared with conventional rockets shows that the cost per pound in final orbit achieved by this method

*** The author is a senior physicist with Elliot-Automation Ltd., of U.K.**



Showing the principle of the ion thruster. Thrust is provided by a beam of positively charged mercury ions. Mercury is vaporised in a boiler and passed into an anode chamber containing an electron source. The electrons from it produce mercury ions which are then extracted by a charge of a few kilovolts.

is decreased to one-third to one-half of the conventional cost; the payload is increased by a factor of 2 to 3½; and the power level increased by a factor of 10-100.

Such large payloads and high power levels offer great opportunities for communication satellite systems. They make possible direct or local television relay to ground stations, a vast number of channels for audio communication, or the possibility of the placement of several satellites in orbit from a single launch.

The useful weight to be established in final orbit depends on the exact manoeuvre to be performed, the efficiency of the thruster, and the power-to-weight ratio of the power-supplying solar cells. This latter fact is a very critical one and development is under way in Britain towards the production of large lightweight solar cell arrays.

This involves the use of new ultra thin solar cells, and the mounting of these on folding or unfurlable substrates, so that the 10m² of area, associated with each KW of power, can be reduced to a compact size during launching. Once the satellite has been placed in its initial orbit, the solar cell array can be deployed, either by a mechanical concertina type of device or by the inflation of unfurlable tubes.

Ion thrusters are being developed in Britain by both private industry and the Royal Aircraft Establishment at Farnborough for the orbit expansion manoeuvre. This type of thruster is capable of very high efficiency, both in terms of the power it requires and the fuel it utilises. Plasma thrusters have not been considered, as they are much less efficient than the ion thruster and are more suited for operation at higher power levels than required at the present.

In an ion thruster, a beam of positively charged mercury ions (caesium is another possible fuel) is ejected from the thruster and used to provide the thrust. In operation, mercury is vaporised in a boiler and passed into a cylindrical anode chamber. At the centre of this chamber is a cathode, the electrons from which are forced to follow spiral paths parallel to the axis by means of a weak axial magnetic field.

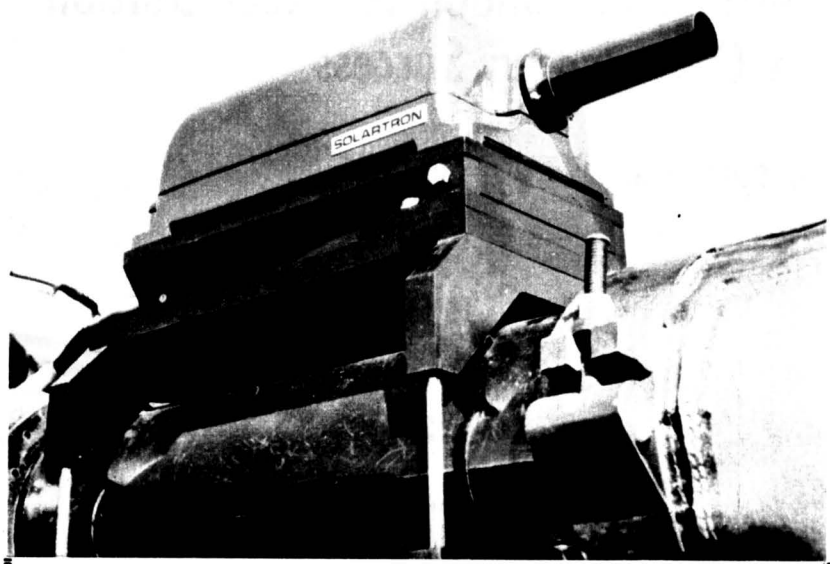
During their long paths, the electrons produce mercury ions which are extracted from one end of the anode by a potential of a few KV. Electrons are prevented from leaving at either end of the anode by a weak repulsive potential so that they undergo many spiral oscillations up and down the anode chamber before finally reaching the anode wall.

In actual satellite operation, the electrical neutrality of the spacecraft has to be maintained by the ejection of electrons into the position ion beam. An electrically heated filament is the simplest neutraliser, although more efficient and reliable neutralisers using plasma sources are under development.

The ion sources described can be efficient both energetically and also in terms of mass utilisation; that is, most of the energy used finally appears in directed kinetic energy of the ion beam, and only a small percentage of the final fuel flux consists of unaccelerated neutral atoms. Figures of greater than 80 per cent can be achieved for both efficiencies.

The main problem with this type of ion thruster is the electron source which has to be efficient energetically and also able to withstand ion bombardment from the plasma in which it is immersed. Devices used so far, with varying lives and efficiences, include simple metal filaments, oxide-coated emitters and electric arcs.

In more advanced designs it is possible virtually to eliminate the problem of cathode life by the use of auto cathodes in which either mercury pool cathodes (for the mercury thruster), or filament emitters continually covered with a caesium monolayer (for the caesium thruster), are employed. These are less further advanced in testing than are the simpler concepts, and will not be used for some time. ■



GUN-PRACTICE WITHOUT SHELLS

The Solartron Company, of U.K., has developed a new type of gunnery simulator which will simplify gunnery training and reduce training costs.

The equipment, called Direct Fire Weapons Effects Simulator, is classed as an optronics device, meaning that it combines the techniques of optics and electronics. It is intended to be used with guided weapons, tanks, helicopters and infantry, and is said to provide a high degree of realism on tactical exercises and range training by enabling "attackers" to engage and disable targets without using live ammunition. Since each firing of a live shell costs up to £200 in U.K. costs savings are considerable.

The simulator is still commercially classified, but Solartron has released the following information on the basic operating principles.

Weapon aiming is simulated by directing a narrow beam of infra-red light produced by a low-powered laser which presents no hazard to personnel. The beam is emitted from a 12in projector mounted on the barrel of the gun used for training. This beam illuminates the target vehicle, or gunnery range screen.

Information relating to accuracy is relayed back to the attacker by telemetry link. The simulator indicates whether a direct hit has been scored, or where the "round" has landed in relation to the target. It also signals the armour thickness of the target, and simulates the precise trajectories for either high explosive or armour-piercing shells.

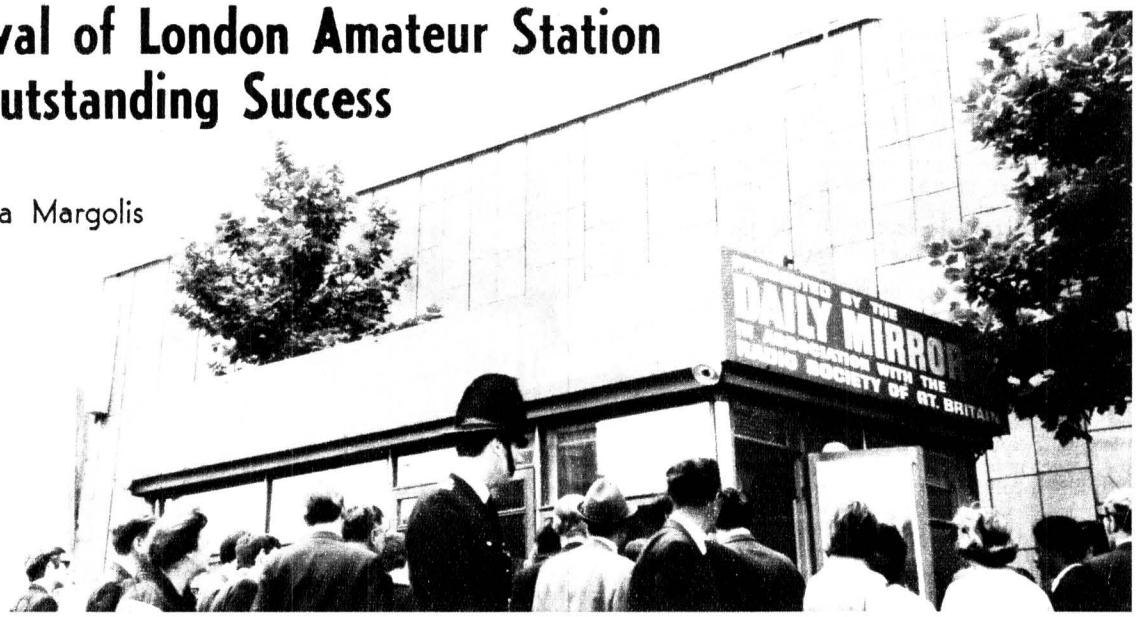
The complete equipment set comprises only five basic items, which can be fitted or removed by a tank crew in less than 20 minutes. The items are: the infra-red projector; detector units which are fitted to the target to receive the light beam; a transmitter/receiver unit; lamp indicator sets for the commander and gunner eyepieces to indicate fall of shot; a small control box, incorporating loader buttons, ammunition counters, "kill" button, range selector.

Solartron has worked on this gunnery simulator for two years, as a private venture, but in close association with the British Ministry of Defence. The Ministry has placed a quantity order for pre-production units for final evaluation trials by the Army.

The picture above shows one of the infra-red projectors mounted on the gun barrel of a tank.

Festival of London Amateur Station an Outstanding Success

By Sylvia Margolis



In conjunction with the recent 1968 City of London Festival, the British amateur radio organisation, Radio Society of Great Britain, installed and operated a short-wave amateur radio station, using the callsign GB2LO.

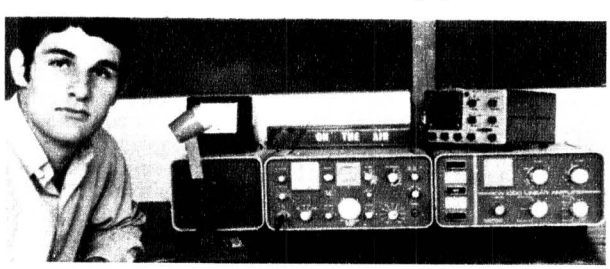
The 1968 City of London Festival included in its program a series of concerts, orchestral recitals, poetry readings, art exhibitions, processions and fireworks displays. Asked what amateur radio has to do with the arts, the R.S.G.B. replied that the ability to communicate was the first of the arts which set man apart from the apes, and made possible his artistic and scientific development.

With station GB2LO, the R.S.G.B. found itself with the biggest publicity program which any amateur radio body anywhere had ever staged. One reason for the sensational response to the project was the callsign adopted by the station. GB2LO brought back nostalgic memories to those with first-hand memories of the first broadcasts from London, in the early 1920s, from the historic 2LO. This station, the first in the world with an advertised public transmission, was originally operated by the Marconi Company, and subsequently by the British Broadcasting Company, forerunner of the British Broadcasting Commission.

Having decided to initiate the project, R.S.G.B. was faced with the problem of finding a site in the crowded city area—by no means an easy task in an area of only 1.03 sq. miles, reputed to be the most expensive piece of real estate in the world. A prominent place was needed, where an aerial could be mounted high and secure above the high buildings which have sprung up in postwar years. There had to be complete total security for the equipment, night and day. The public must have access, yet it had to be controlled access, where the inevitable crowds of sightseers would not cause an obstruction in the street.

It was the mass-circulation newspaper "The Daily Mirror" which provided the solution to this problem, by agreeing to play host to GB2LO. Not only did they provide the site, but they obtained permission to erect a building and the antenna. They hired and set up the building, provided skilled labour for the installation of the aerial and maintenance of the station, supplied furniture, power, a direct telephone line, all the display material, publicity sheets and 1,500 attractive QSL cards. They hired a policeman by day to control the crowds and security men by night to guard the equipment. With such splendid co-operation, R.S.G.B. had only to provide the radio equipment and maintain a rota of volunteer amateur operators for the duration of the Festival.

G3UML with the GB2LO equipment.



The R.S.G.B. decided to use commercially made equipment because the idea behind GB2LO was not to demonstrate the ability of radio amateurs to devise the means to communicate, but their unique privilege of being able to speak to friends all over the world, in the cause of international friendship. The equipment had to function continually for two weeks and should any breakdown occur in this period one commercial rig could be substituted for another within minutes.

The station equipment therefore comprised a KW-2000A transceiver with KW-1000 linear amplifier, manufactured by KW Electronics, Dartford, Kent, U.K.; and a fibreglass cubical quad aerial. This aerial was mounted nearly 200ft above ground, on the roof of the "Daily Mirror" building. It was designed to operate on 15 and 20 metres, with trap dipoles for 10, 40 and 80 metres. The fibreglass construction enabled the quad to withstand two bouts of 70 m.p.h. summer gales.

The station was formally opened on July 8 by R.S.G.B. president John Graham, G3TR. Thereafter, with about a dozen very carefully picked operators working in shifts, 108 countries were contacted in 1,500 two-way contacts. For several hours each day, the station was open to the public, and during this period, the station continued in full operation. For most of the time when the station was on the air, transmissions were relayed to the street outside via a P.A. system.

The combination of the rare "GB" prefix with the historic "2LO" caused the station to be so sought after by amateurs all over the world that several all-night sessions had to be arranged. One experienced DXer who participated in one of the all-night sessions said he had never heard such pile-ups chasing a single station.

An estimated 40,000 people visited GB2LO during its two weeks in operation, including many radio amateurs from overseas, as well as a large number of British amateurs. Among those welcomed from overseas was Mr K. C. Seddon, VK3ACS, secretary of the Victorian Division of the Wireless Institute of Australia. Another visitor was the Lord Mayor of London, who was delighted to receive greetings from W2RP of New York on 21.339MHz. The American was said to be almost incoherent with excitement and confessed afterwards that the contact had been his most thrilling moment of his many years as a radio amateur. Another notable incident was the contact with W1AW, the official station of the American Radio Relay League. This was the first time there had been an official amateur radio contact between R.S.G.B. and A.R.R.L. ■

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TYPICAL TRADE-IN VALUATIONS ON A LUX SQ-1220

The maximum you will pay with your Leak "Stereo 30", Leak "Stereo 20" (with Varislope pre-amp.) or Fisher 101 will be **$190.** With your Quad Mk. II pre-amp. and power amplifier the amount will be a maximum of **$120.** And it could well be even less!

TYPICAL TRADE-IN VALUATIONS ON A LUX SQ-77TW

Changing up to a silicon transistor stereo amplifier can be quite economical; if you trade your Leak "Stereo 30", Leak "Stereo 20" (with Varislope pre-amp.), Fisher X100A or Pioneer SM83 your new amplifier will cost you a maximum of **$30** With your Peak TRM-40 you will pay only **$70,** with your Star SA-30 the cost will be **$120** and with your Linmark SA-200 the changeover will cost a maximum of **$145.** If your equipment is in excellent condition your payout can be substantially less!

HIGH FIDELITY STEREO PHONES COST LESS AT ENCEL ELECTRONICS!

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LOWTHER LOUDSPEAKERS FROM ENCEL ELECTRONICS!

The well-known Lowther Model PM6 (17,500 lines) is now available on immediate delivery. Write for EMQ's or call for your personal quotation. Cabinet drawings available on request.

DRAMATICALLY EFFECTIVE TAPE STEREO SYSTEM WITH A TUNER/AMPLIFIER FOR ONLY $415

Encel Electronics supplies an Akai Model 3000D stereo tape deck with three heads and silicon transistor circuitry, the Compax Model CE-5000 stereo tuner/amplifier with an output of over 80 watts IHFM, a matched pair of Sonics Model AS-61 speaker systems. Each hand finished teak/walnut ensclosure houses 4 bass/mid-range speakers and a high frequency speaker. Encel price inc. sales tax . . . **$415**

A PRECISION TONE ARM WHICH WILL TRACK AT ¾ GRAM FOR ONLY $19!

The Nikka-Lustre Model CP3 is an excellently engineered instrument which will track down to ¾ gram with suitable cartridges. An open-front headshell accepts all standard ½" mounting cartridges —and the arm takes Ortofon and SME cartridges without modification. Miniature ball races are used throughout; an outrigger bias adustment sets stylus pressure. A tailored lifting/lowering device is now available for only $7.50 more . . . if you order the lift with the arm, price is only $23! Action of the lift is pneumatically dampened. See the review of the CP3 arm in your October, '66 copy of "Electronics Australia" . . . or write to us and we will send you a copy.
Price (including Sales Tax) **$19**
Price with lift **$23**

NOW . . . SHURE CARTRIDGES AT ATTRACTIVE ENCEL PRICES!

Perhaps you've been saving for a Shure Cartridge . . . now you can make your purchase sooner than you expected. Encel prices include sales tax, all cartridges are brand new, each one is fully guaranteed.

Model M44G Retail 26.00 ENCEL **$19.50**

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Model M75 E Retail $69 ENCEL **$42.50**

Model V15E Mk. II Retail $118.75 ENCEL **$74.50**

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GRACE TONE ARMS . . . FOR THE PERFECTIONIST!

Two models of this sophisticated arm are available . . . the 12" G-540L and the 14" G-560L. A gimbal type gyroscopic bearing is used — and the Grace arm will track suitable cartridges down to ¼ gram with ease. A super light-weight head shell is supplied. Since this arm became available at Encel Stereo Centres many fastidious enthusiasts have traded much more expensive arms of Continental origin. Encel prices inc. sales tax . . . G-560L **$34.50** **$42.50.** G-540L

NEW TONE ARM LIFT . . . THE COLTON "VARILIFT" . . . ONLY $9.50!

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Celestion 12 in. co-axial loudspeakers have been received most enthusiastically by audio enthusiasts and music lovers in Australia. Clarity, transient performance and attack are particularly satisfying. Both models feature co-axial tweeters with electrical cross-overs at 4 kHz.

STANDARD 12" CO-AXIAL CX1512

The Standard Model CX1512 has a frequency response conservatively quoted at 30-15,000 Hz. and is rated at 15 watts R.M.S. Encel Price including Sales Tax **$39.50**

DELUXE 12" CO-AXIAL CX2012

The "Celestion" Deluxe Model CX2012 is rated at 20 watts R.M.S. and frequency response is conservatively quoted at 30-18,000 Hz. A special "Brilliance" control operates in the tweeter circuit — the electrical cross-over is at 4 kHz. See reviews in the "Gramophone", p. 511, April, '65, and "Hi-Fi News", p. 75, June, '65. ENCEL PRICE CX2012 (inc. Sales Tax) **$59.00**

CELESTION "DITTONS" ARE NOW AVAILABLE!

Both the "Ditton 10" priced at $59 and the new "Ditton 15" which sells at $89 have proved very popular in Australia. Ask for complete specifications.

MICRO DUST PICK-UPS

This most effective record cleaner automatically removes dust and static charges as the record is being played **$3.50**

MICRO TONE ARMS OFFER OUTSTANDING VALUE!

Designed to track effortlessly with the most sensitive and delicate cartridges, Micro arms accept SME and ORTOFON head shells without modification. The Micro head shell accepts any standard ½" mounting cartridge. Vertical and horizontal movement is almost friction-free — tracking pressure is adjustable from 0.5 grams. Model MA88 (16") is priced at **$35.50.** Model MA77 (14") and MA77S (12") are only **$29.50.** Encel prices include sales tax.

LIFT NOW AVAILABLE FOR MICRO ARMS

A tailored lifting/lowering device is now available for all Micro arms. Easily fitted, pneumatically dampened action **$8.50**

WHARFEDALE SPEAKERS

A complete range of world famous Wharfedale sound reproducers is always available at Encel Stereo Centres . . . write or call for an EMQ or a trade-in valuation. Models include Super 3, Super 5, Super 8, Super 10 RS/DD, Super 12 RS/DD, W12/FRS, W15/RS, PST/4, 8" Bronze RS/DD, 10" Bronze RS/DD, Golden 10 RS/DD and the 12RS/DD. Complete enclosures available include the "Denton" and the "Super Linton".

SAVE WITH AN ENCEL QUOTE ON YOUR NEW SANSUI AMPLIFIER

The full Sansui range is available—and Encel end-user prices are most attractive. Trade-in valuations on your old equipment are also at an all time high . . . so ask for a price now! Choose from the Models 220, 500A, 1000, 2000 and 3000A!

LOOKING FOR AN ADC CARTRIDGE? SEE ENCEL ELECTRONICS WITHOUT DELAY!

A full range of renowned ADC cartridges is now available and Encel prices cannot be advertised. However you can overcome this tragedy by writing for a personalised quote or a trade-in valuation. You'll save more at Encel Electronics!

SOUND MODEL SAQ-505X — HIGH OUTPUT STEREO AMPLIFIER FOR $119.50!

Power output of the 505X is 25 watts R.M.S. in each channel into an 8 ohm speaker load. Frequency response is 20-20,000 Hz. plus or minus 1 dB. Sensitivity is 3 mV. for magnetic cartridges, all normal controls are provided as well as tumble switches for loudness, rumble, tape monitoring etc. **$119.50**

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	Rating at 70°C	1. Semi Precision	2. High Stability	3. General Purpose
Electrosil **TR4 Style** resistors		1/16 w	1/8 w	1/4 w
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Electrosil **TR8 Style** resistors		1/2 w	1w	2w
Load life stability:	2,000 hours at 70°C	0.5%	1.0%	2.0%
	25,000 hours at 70°C	1.0%	2.0%	3.0%

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THE COMPONENT CAPABILITY COMPANY

Amateur Weather Pictures

Amateurs in many countries are now receiving pictures from various weather satellites. How it is done and how it is started is told in this story taken from RCA "Electronic Age" and written by Morris M. Lewis, Jun.

Early in this century, fledgling radio amateurs fiddled with receiving sets, made of such items as empty oatmeal boxes, curtain rods, and spent rifle shells. Hovering over their makeshift rigs to pluck faint signals from the airwaves, they were in the vanguard of a movement that has seen radio bloom into a science, typified by world wide communications and interplanetary space probes.

Yet, this progress has by no means stunted amateur pioneering. The modern-day counterpart of the amateurs of the early 1900s is the growing coterie of "space amateurs" in several countries who use rolling pins, inexpensive electric motors, and similar makeshift gear, to receive pictures of the earth from TV-equipped TIROS, ESSA, and Nimbus weather satellites orbiting hundreds of miles overhead.

On a single pass of a satellite over the eastern United States, for example, space amateurs now receive pictures covering areas from northern Greenland to the Yucatan Peninsula in Mexico. Many of these amateur-produced space pictures contain startling detail, showing weather phenomena such as hurricanes and terrestrial features such as the St. Lawrence River, Long Island and the Florida Peninsula.

The originator of this new space-age hobby is Wendell G. Anderson, a veteran radio amateur and an engineer at RCA Defence Electronic Products in Moorestown, N.J. Anderson received his first space pictures in 1964 on what he describes as "relatively crude equipment" hastily assembled in his basement. The photographs were good enough to spur him on to further experimentation.

The basement receiving station was put together primarily from a 30-year-old amateur radio set plus the usual surplus equipment accumulated by most amateurs. Also a common kitchen rolling pin, two electric motors costing $10 each, a second-hand microscope costing $15, and an argon electric light bulb. The total outlay about $200.

The antenna was fashioned from a piece of wire mesh and a 30-foot length of copper tubing held in place by wooden dowels. Its vertical movement is controlled by commercial TV antenna rotators.

By reporting on his early successes in an amateur radio magazine, Anderson launched an entirely new hobby for radio amateurs. He now corresponds regularly with more than 150 individuals in the United States, Canada, India, Italy, the Netherlands, South Africa, Turkey, and West Germany.

Persons and groups interested in building their own satellite picture receivers range from amateurs who have retired, to High school students. In fact, students at one technical school blend academic training with space-age interest by building a receiver each year as part of their electronics course.

Anderson estimates that there are now about 50 amateur stations in operation with a similar number under construction.

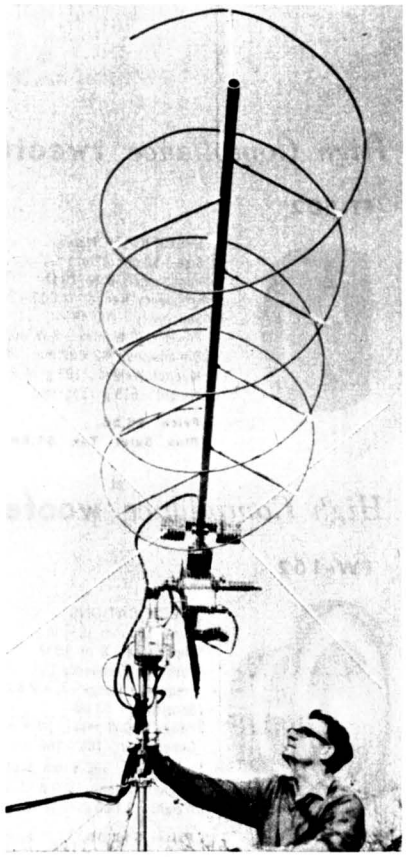
To receive a picture from the satellite, Anderson tunes in the signals and records them on an ordinary home tape recorder. The impulses are used to activate the argon bulb, and the resulting beam is put "backwards" through the microscope to focus it to a sharp point. The beam is then aimed at unexposed photographic film affixed to the rolling pin, which is rotated by one of the electric motors.

The rolling pin makes one revolution for each of the 800 TV lines that make up the satellite pictures. The exposed film is then processed in Anderson's darkroom.

Many of the newer space amateurs bypass the darkroom process by using Polaroid cameras to record the pictures directly from an electronic scope. The recorder may also be by-passed if the picture is produced directly on film or the Polaroid positive as it is received from the satellite. Most amateurs prefer, however, to tape the signals so additional pictures can be produced from them.

To practise the hobby, amateurs require a good background in electronics plus a certain degree of ingenuity. Some High school studentns who have attempted to build sets for their science fairs have found the project beyond their limited know-how.

Pictures can be received only from those satellites equipped with Automatic Picture Taking (APT) equipment, such as the ESSA 6 launched in November, 1967. The APT equipment was specially designed by NASA and the Enviromental Science Services Administration of the U.S. Department of Commerce to allow direct transmission to relatively simple receiving equipment. ■



Wendell Anderson with his home-made antenna.

TROPOSPHERIC PROPAGATION RESEARCH

The successful application of frequencies above about 30MHz in terrestrial and space communication systems requires a knowledge of the refractive-index variations in the troposphere. These variations are caused by changes in humidity and temperature and hence depend on meteorological conditions. Some research in this field is in progress in the Radio and Space Research Station of the Science Research Council, Slough, England. Workers at this laboratory have been carrying out direct measurements of the small-scale fluctuations of refractive index using a microwave refractometer on a large captive balloon or suspended from a helicopter. This equipment transmits the information to a ground station for recording and analysis.

Many of these soundings have been combined with soundings of the troposphere with high-power radars and good correlation has been obtained between the irregular refractive-index structure and the location of radar echoes from clear air, the so-called "angel echoes." The measurements have also been combined with observations of the fading on VHF beyond-the-horizon links so located that their mid-point was near the balloon and radar site. In this work remarkably sharp local gradients in the refractive-index structure have been observed in stratified layers. These play an important role in "scatter" propagation.

These studies are closely related to some work in progress in Australia: for example, in the Postmaster-General's department on VHF and UHF propagation over Bass Strait. In addition, work at the Weapons Research Establishmen, Adelaide, on acoustic sounding of the lower troposphere shows evidence of a stratified structure very similar to that observed in the work in England.

(See also our cover picture and cover caption on page 1).

foster hi-fi speakers

High Compliance tweeters

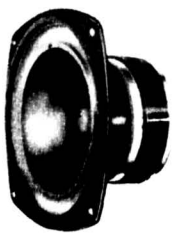
FT-502

SPECIFICATIONS
Size : 50 mm (2 in.)
†Impedance : 8 or 16 Ω
Frequency Range : 2,000 ~ 20,000 c/s
Sensitivity : 100 dB
Power : 30 W max., 8 W nom.
Dimensions : 82 × 82 mm, 29 mm depth
Magnet Weight : 193 g (6.81 oz), Ceramic
Weight : 615 g (1 3/8 lbs)

Price $8.04.
Plus Sales Tax $1.68.

High Compliance woofers

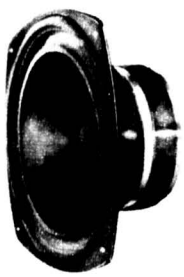
FW-162



SPECIFICATIONS
Size : 160 mm (6 1/2 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_o) : 40 ~ 50 c/s
Frequency Range : f_o ~ 2,000 c/s
Sensitivity : 97 dB
Power : 30 W max., 10 W nom.
Dimensions : 166 × 166 mm
81.6 mm depth
Magnet Weight : 500 g (1 1/8 lbs), Ceramic
Weight : 1,660 g (3 11/16 lbs)

Price $12.00.
Plus Sales Tax $2.50.

FW-202

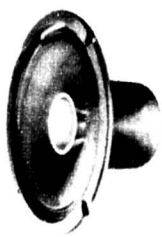


SPECIFICATIONS
Size : 200 mm (8 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_o) : 30 ~ 40 c/s
Frequency Range : f_o ~ 2,000 c/s
Sensitivity : 98 dB
Power : 45 W max., 15 W nom.
Dimensions : 208 × 208 mm
90.8 mm depth
Magnet Weight : 830 g (1 13/16 lbs), Ceramic
Weight : 2,760 g (6 1/16 lbs)

Prices $23.64.
Plus Sales Tax $4.93.

Double-cone speakers

PW-65A



Size : 160 mm (6 1/2 in.)
*Impedance : 8 Ω
Resonant Frequency (f_o) : 70 ~ 100 c/s
Frequency Range : f_o ~ 15,000 c/s
Sensitivity : 97 dB
Power : 6 W max., 5 W nom.
Dimensions : 164.9 ϕmm, 86.2 mm depth
Magnet Weight : 77.6 g (2.73 oz)
Weight : 476 g (1 1/16 lbs)

Price $6.60.
Plus Sales Tax $1.35.

*at 400 c/s; †at 3,000 c/s

High Compliance wide range speakers

FE-103

Price $8.64.
Plus Sales Tax $1.04.

Size : 100 mm (4 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_o) : 65 ~ 95 c/s
Frequency Range : f_o ~ 18,000 c/s
Sensitivity : 96 dB
Power : 5 W max., 3 W nom.
Dimensions : 105 × 105 mm, 46.6 mm depth
Magnet Weight : 193 g (6.81 oz), Ceramic
Weight : 630 g (1 3/8 lbs)

FE-163

Price $14.64.
Plus Sales Tax $3.05.

Size : 160 mm (6 1/2 in.)
*Impedance : 8 or 16 Ω
Resonant Frequency (f_o) : 40 ~ 60 c/s
Frequency Range : f_o ~ 20,000 c/s
Sensitivity : 98 dB
Power : 10 W max., 5 W nom.
Dimensions : 166 × 166 mm, 73.7 mm depth
Magnet Weight : 398 g (14.04 oz), Ceramic
Weight : 1,260 g (2 3/4 lbs)

Coaxial speakers

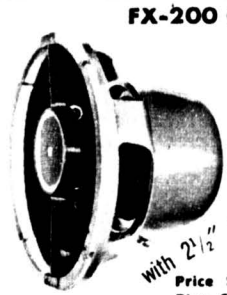
FX-201

with horn tweeter

Prices $23.88.
Plus Sales Tax $4.98.

Size : 200 mm (8 in.)
*Impedance : 16 Ω
Resonant Frequency (f_o) : 45 ~ 75 c/s
Frequency Range : f_o ~ 18,000 c/s
Sensitivity : 101 dB
Power : 10 W max., 5 W nom.
Dimensions : 206 ϕmm, 137.5 mm depth
Magnet Weight : 240 g (8.46 oz)
Weight : 2,200 g (4 7/8 lbs)

FX-200 G2



with 2 1/2" tweeter

Price $21.60.
Plus Sales Tax $4.50.

Size : 200 mm (8 in.)
*Impedance : 16 Ω
Resonant Frequency (f_o) : 45 ~ 75 c/s
Frequency Range : f_o ~ 18,000 c/s
Sensitivity : 101 dB
Power : 10 W max., 5 W nom.
Dimensions : 206 ϕmm, 140.7 mm depth
Magnet Weight : 234 g (8.21 oz)
Weight : 2,200 g (4 7/8 lbs)

2-way network

LC-100
Price $6.60.
Plus Sales Tax $1.38.

Crossover Freq.: 2,500 or 3,500 c/s
Impedance : 16 Ω
Attenuation : 6 dB/oct.
Dimensions : 63.1 ϕmm, 69 mm height
Weight : 280 g (9.88 oz)

2 or 3-way network

LC-300

Crossover Freq.: 350 or 700 c/s, 2,500 or 5,000 c/s
Impedance : 8 or 16 Ω
Attenuation : 6 dB/oct.
Dimensions : 83 H × 200 W × 134 mm D
Weight : 1,430 g (3 1/8 lbs)

Price $22.20.
Plus Sales Tax $4.63.

tweeter

FHT-1

Price $11.04.
Plus Sales Tax $2.30.

†Impedance : 16 Ω
Frequency Range : 2,500 ~ 16,000 c/s
Sensitivity : 100 dB
Power : 10 W max., 5 W nom.
Dimensions : 110 mm height, 95 mm depth
Weight : 330 g (11.75 oz)

FHT-1

(SOLE AGENT) ZEPHYR PRODUCTS PTY. LTD.
70 BATESFORD ROAD, CHADSTONE, VICTORIA

AUSTRALIA'S 13-CHANNEL TV SYSTEM

. . . an outline of its development

The television service available in Australia is of a high standard and, except for a few difficult locations, compares more than favourably with that available to viewers overseas. The decisions concerning channel allocations which have contributed in large measure to this situation, are outlined in this article.

By Brian Carroll

The allocation of the channels for television services is the responsibility of the Australian Broadcasting Control Board, established by Act of Parliament in 1949. At that time, television was still seven years away in Australia, but one of the immediate duties of the Board was to plan for the introduction of a public television service. The need for careful planning in the allocation of frequencies for television had already been amply proved in other countries, notably in the U.S.A., where the situation was anything but orderly. In that country, the Federal Communications Commission had to place a complete embargo on new stations until the mess which had developed could be sorted out. Even so, they had to resort to a dual system, with VHF stations side by side with UHF stations.

When Australia first looked at television channels, the Chifley Government had a simple answer to the problem. There would be only national television, and no more than three channels would be needed for that. In its first report, the Control Board observed that these could be provided in the 178 to 200MHz band. Additional nearby channels could be made available later if they were needed.

This particular plan never got off the ground, because the Chifley Government lost office at the 1949 election. Menzies took over in December, 1949, and by February, 1950, the Control Board had already reported on ways of implementing the new Government's policy of issuing television licences to private enterprise.

This meant that more channels would be needed. So the Board set about finding them. By stretching the band already set aside, it would be possible to fit five channels between 174 and 216MHz. There was also a good prospect of getting two more between 47.5 and 70MHz. Even at this early stage the Board had discussed the 90 to 108MHz band and its likely value for an FM service. It said, "although reserved for frequency modulation broadcasting it had not so far been used to any extent for this purpose." All told, this made a total of nine channels, which seemed likely to meet Australia's needs. At that time, the United States had 12 channels, the United Kingdom five.

When the Royal Commission on Television met in 1953, it took an interest in the frequency position. It asked the Control Board to prepare a number of specimen assignment plans, so it could assess what sort of service would be available from the seven channels definitely available. It was not, at this point, seriously considering using the FM band.

One of the Board's plans began by setting aside three channels for each capital city, and two for Newcastle. This meant that every town with over 5000 people could have one channel, but many of them would not be able to have two.

Another plan allocated five channels to capital cities. This left a shortage for other places. Many towns of over 5000 people just would not be able to get a channel at all. Even fewer would be able to have two.

There was some pressure on the Royal Commission to recommend parallel development of VHF and UHF from the very beginning. This came mainly from the Australian Federation of Commercial Broadcasting Stations. But the Commissioners thought it better to recommend that initially television should be limited to VHF channels. Steps should be taken to ensure that more VHF channels were made available, if that were at all possible. Now they too had their eyes on the FM radio channels. And to ensure systematic development, an immediate frequency assignment plan should be worked out, they said.

Once the Royal Commission was over, the Australian Broadcasting Control Board (A.B.C.B.) settled down to the chore of working out such a plan. First it had to clear up the matter of just which channels would be available. Talks between the Board, Post Office, and other users of channels started in June, 1954. A new 10-channel system emerged from these discussions. These channels and their frequencies are listed in Table 1. So far, the FM channels had escaped. And it did not seem important at this stage that Channels 4 and 5 would not become available until July, 1963.

Based on this 10-channel system, the Board worked out an elaborate frequency assignment plan. Each capital city had four channels, and every town with over 5000 people had coverage from at least two. It is interesting to look back on this plan, in the light of subsequent events. Once television started, actual coverage of metropolitan stations turned out to be rather more widespread than originally expected, so there was no need to adopt the early proposals to have television stations in such places as the Blue Mountains and Geelong.

TABLE 1

Ten-Channel Frequency Plan used from 1954 until 1960.

Channel	MHz
1	49-56
2	63-70
3	85-92
4	132-139
5	139-146
6	174-181
7	181-188
8	188-195
9	195-202
10	209-216

Channel 3 was limited to use in inland country areas only. Channels 4 and 5 were not available until July 1, 1963.

TABLE 2

Thirteen-Channel Frequency Plan used since 1961.

Channel	MHz
0	45-52 *
1	56-63 *
2	63-70 †
3	85-92 §
4	94-101§
5	101-108 §
5A	137-144 *
6	174-181 †
7	181-188 †
8	188-195 §
9	195-202 †
10	208-215 †
11	215-222 *

* available from January 1, 1962.
† already in use.
§ available immediately.

When the first television sets were made in Australia, this 10-channel system was in force. Hundreds of thousands of sets were made to these standards, and they were used for the introduction of television in all six capital cities.

Channel 2 was allocated to the national station in each city, and Channels 7 and 9 to the commercial stations. Perth had only one commercial station, which was allocated Channel 7. Hobart's only commercial station was given Channel 6.

So far so good. But once the A.B.C.B. began to look at starting television services in the country, it was made clear that some technical problems had to be faced. Country television was coming sooner than expected, so the fact that Channels 4 and 5 would not be available until July, 1963, could throw a spanner in the works. There were even suggestions that Channel 4 might not be available at all.

In April, 1960, a conference was held to discuss the frequency issue. The 40 experts who attended represented not only the A.B.C.B. but the

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P.M.G.'s Department, the A.B.C., the C.S.I.R.O., applicants for the first 13 country licences, set manufacturers, and existing television stations.

Their most important quandary was whether the UHF band was to be used, or if television was to be kept within the VHF band. It was decided that provided adequate channels could be found to develop television within the VHF band, then this was the better course. For one thing, the public already had something like a million VHF sets. Moreover, the industry was already familiar with VHF techniques, so it seemed a more efficient and economical service would result from keeping to VHF parts of the spectrum.

At that time, the nine available channels—Channel 4 had been written off—were enough to provide an additional channel in each capital city, and two stations in all other places. If the FM radio bands went over to television, the two extra channels would make it possible for all provincial areas to have three stations.

But if a long view were to be taken, it seemed better to have a system which permitted five stations in each capital and four in each provincial area. All this needed was a seemingly modest increase from 11 to 13 channels.

A decision had to be made. If sufficient VHF channels could not be found, it would be necessary to go into the UHF bands, where 45 channels were reserved for television. And if it were necessary to use UHF, there were strong reasons for developing country and provincial areas in UHF. This would avoid problems of intermixture which would occur if the decision were put off.

Happily, a solution was found. The Board's report and recommendations were sent to the Postmaster-General, who announced in December 1960, that a new 13-channel system would be adopted for Australian television. These channels and their frequencies are listed in Table 2. Of course, this meant that the FM radio channels had to go.

There were some quite ingenious aspects to the new system. It carefully avoided any change to established station frequencies. Channels 2, 6, 7, 9 were not altered. Ten-channel sets would still work quite satisfactorily for their metropolitan owners. They would also work on Channels 3 and 8, which were not altered. They would very likely be satisfactory for the new Channel 10, which was only 1MHz different from the old channel.

Still, there were some problems. Six of the 13 channels were completely new. So viewers with 10-channel sets in areas where these channels were allocated would not be able to get all available stations, unless they had their sets modified. In the initial stages this applied mainly to national stations —Newcastle's A.B.C. station was given Channel 5, the Illawarra station Channel 5A, the New South Wales Central Tablelands area Channel 1, Bendigo Channel 1, the Latrobe Valley Channel 4. Since most of these areas were new to television, there were not many 10-channel sets in them.

Biggest of all such problems in the first allocation of channels under this new plan was that faced by the commercial station at Wollongong. It was allocated Channel 4. Yet Wollongong was one area with a fairly high penetration of 10-channel sets, because reception from Sydney was good enough to have encouraged many people to install television receivers. Since they already had a choice of three stations, there was not a high incentive to buy a new set, or even have their existing one modified. It was a problem that took the Wollongong station years to overcome.

Some new technical requirements applied to provincial stations. Even with 13 channels, there was a need to husband them carefully. So as well as directional aerials, some of the new stations had vertical polarisation, and frequency offsets from the standard channel. These measures could enable pairs of co-channel stations to operate at moderate spacings with minimum mutual interference.

Commercial stations at Shepparton and Ballarat were cases in point. Although fairly close together, both stations would use Channel 6. Ballarat would use horizontal polarisation, and its aerial would minimise radiation in the direction of Shepparton. Shepparton would have vertical polarisation and its aerial would minimise radiation in the direction of Ballarat. As well as at Shepparton, there would be vertical polarisation at Canberra, Orange, and Bendigo.

Some of the frequency offsets were necessary to avoid interference with radio services close to the television sites. They would have no noticeable effect on the tuning of television receivers. But they would make it possible to use that channel in that place.

(EDITOR'S NOTE: Areas in which vertical polarisation is used have had some trouble with ghosting, notably the Cooma district of N.S.W. Latest reports indicate that the A.B.C.B. is now considering the use of translators in the areas worst affected by ghosting.)

Once the 13-channel system settled down it seemed to have solved most of the frequency allocation problems for a long time. From the beginning of 1961, all new sets were made to revised specifications. As people replaced their existing sets, the likely usefulness of the new channels in metropolitan areas began to increase.

But the process was not quick enough to solve all the problems. When it was decided that Sydney, Melbourne, Brisbane and Adelaide were ready for their fourth television channel, the question of a channel arose. In Sydney and Adelaide the problem was fairly easily solved. Channel 10 was allotted.

No such solution offered in Melbourne and Brisbane. Channel 10 had already been issued to stations at Traralgon in Victoria, and Toowoomba, in Queensland — each too near the capital for that channel to be used.

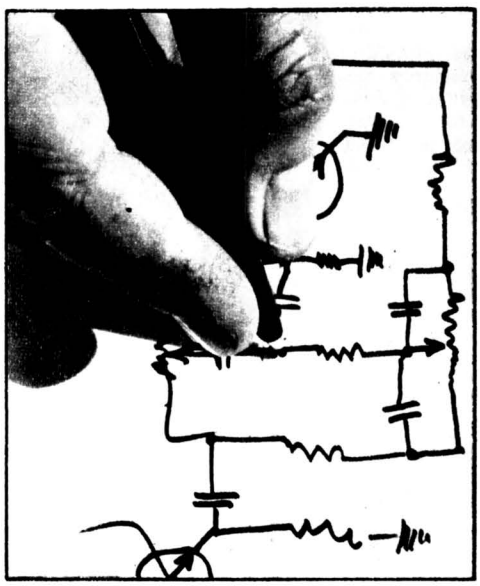
When Channel 0 was allotted to these cities, there was a rumpus, because hundreds of thousands of sets would not be able to receive it unless they were modified. The Postmaster-General found it necessary to issue a long statement about the technical aspects which led to the decision. He remarked that in Britain, millions and millions of one-channel sets had to be modified when the commercial stations started.

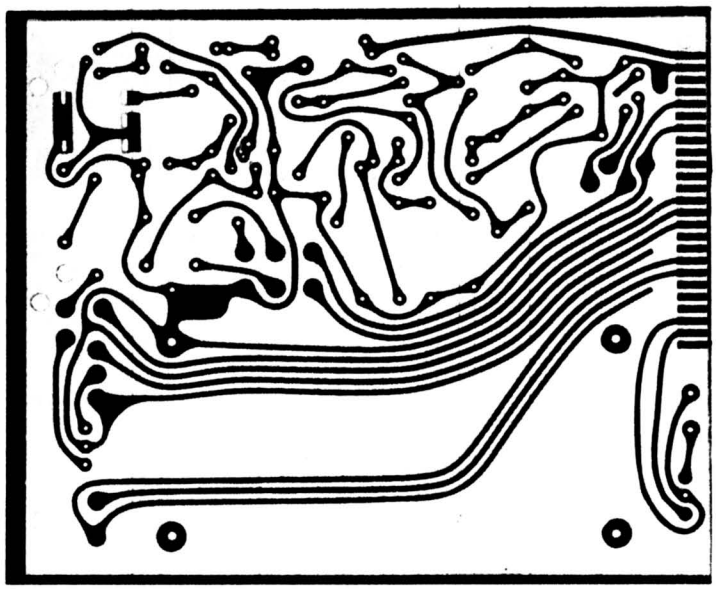
In Melbourne, Channel 0 embarked on a massive newspaper advertising campaign, urging people to trade in their ten-channel set or have it converted. By the time the station started regular transmission, 67 per cent of Melbourne sets could get Channel 0. Eventually, time took care of the problem. Nowadays there are not too many sets left in Melbourne or Brisbane that are not able to pick up Channel 0.

With these few difficulties, the 1960 revision of television frequencies seems to have worked well enough. Something like 95 per cent of Australians now have a choice of at least two television programs. Many have a lot more. Those who live in the metropolitan areas have at least four. Occasional lucky viewers live close enough to a capital to get its four stations, and far enough into the country to bring in two or three more. Those isolated areas that are still without television are not likely to have trouble in getting television frequency channels assigned to them. ■

Spiders not yet obsolete

Spiders are still in demand in Britain. Their strong and extremely fine threads continue to be used for markings in optical instruments such as theodolites. Photographic printing and vacuum deposition of metals on glass have taken over from spider webs in new instruments, but the threads—0.0003in diameter—are still required for repairing old instruments. Vickers Ltd., of north-east England, conducts an annual hunt for a spider work force, and here an apprentice at the firm is practising the approved method of inducing spiders to sign up. Unfortunately, when this picture was taken, the females of the species Epeira Diademata — the unpaid non-union labour which produces just the web needed — were not looking for employment and as a suitable specimen living au natural could not be found, a spider already gainfully employed by the company was used for this demonstration.





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Technical Review

NEW THEORY OF SOLAR SYSTEM FORMATION

British cosmologist Professor Fred Hoyle, noted for his controversial theories, has again given astronomers cause for reflection by propounding a new theory, concerning the beginning of our solar system, which is at variance with generally accepted ideas.

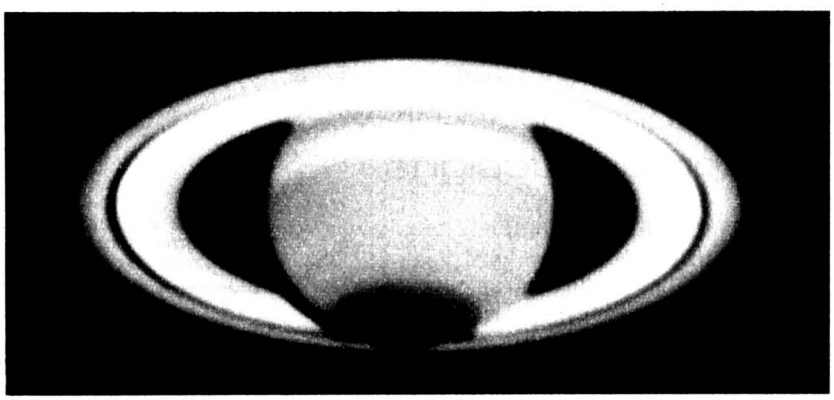
Professor Fred Hoyle

According to "orthodox" theory, the Earth and the other planets were formed in a relatively cold state and have somehow got warmed up since. At one time astronomers thought that the planets were formed when another star came too close to our own Sun and pulled a great streamer of gas out of it, which later solidified and split up into the planets. But today most people believe that no other star had to be involved. Both the Sun and the planets were formed when a huge cloud of gas contracted under the influence of gravity. Up till now, it has been generally agreed that this cloud of gas was cold and so the planets were formed as cold objects when they condensed out of it. The fact that the Earth has a hot, molten core, according to this established concept, is due to events since it was formed.

Recently, the distinguished British cosmologist and mathematician Professor Fred Hoyle, with his colleague N. C. Wickramasinghe, has put forward a new theory which states that the Earth and other planets were made hot, and have cooled down since. The theory may be supported by recent startling evidence, from photographs taken from Lunar Orbiter spacecraft, that the Moon has been in frequent volcanic eruption, over periods of many millions of years, and may even still have a hot core like the Earth. Professor Fred Hoyle's new version of the creation of the solar system begins in the usual way, with a cloud of gas much bigger than today's system. The cloud contracted under the influence of its own inward-pulling gravitation — and this gravitational energy turned into heat. Hoyle's calculation shows that by the time the cloud had shrunk to a hundred million miles across, its temperature would have gone up to 3000° or 4000° Centigrade.

To an astronomer somewhere else in space, the cloud would then have looked like a very bright star and Hoyle points out that this is a familiar stage in the life history of stars as observed from Earth, their so-called over-luminous phase. At this stage the speed of the inward collapse would increase and as the cloud shrank, so it would have rotated faster and faster —just as an ice-skater spins faster and faster if she draws her arms in. During this spinning, something like five-sixths of the original mass of the cloud was thrown out into space.

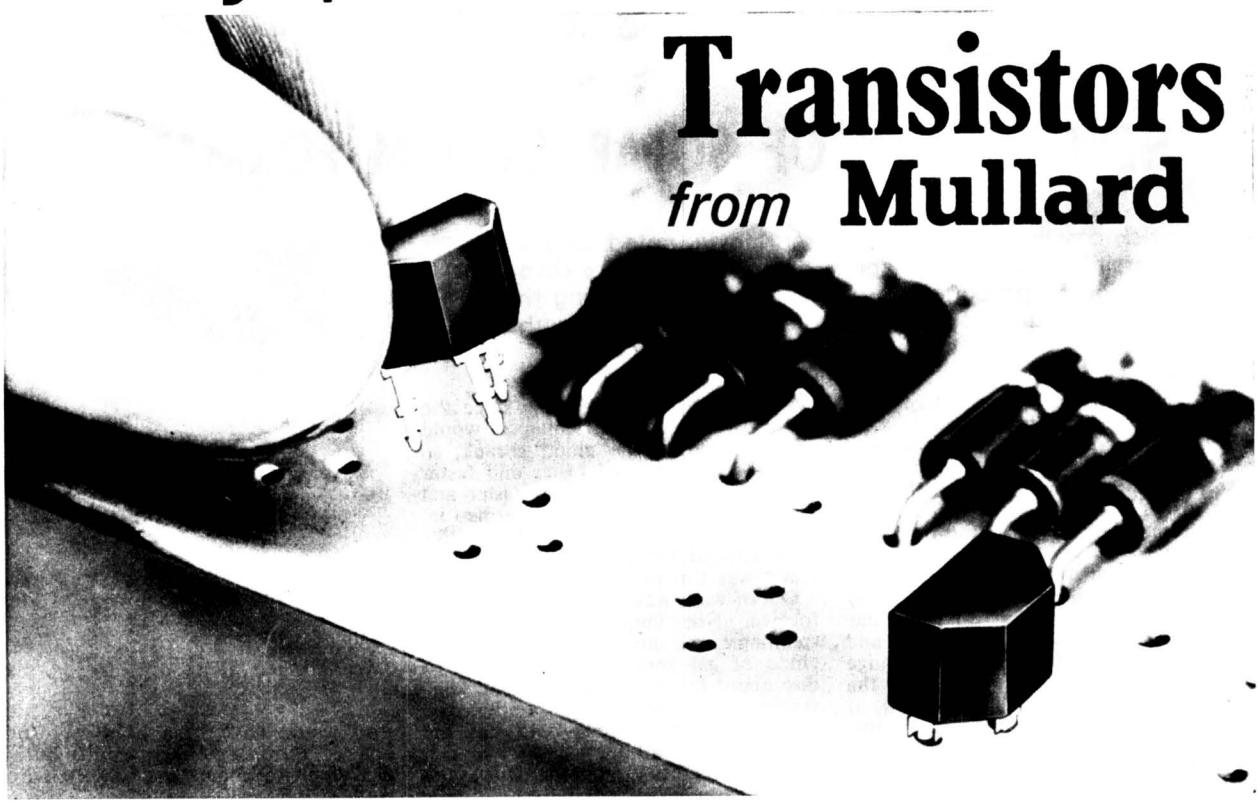
Out of what was left, the planets were formed. Not immediately—the rapid spinning first made the contracting cloud of gas spread out again, into a disc about the size of the present solar system. The outer edge of the disc would have been quite cold but the centre would still have been above a thousand degrees Centigrade. Out at the edge of the spinning disc, oxygen and nitrogen would liquefy in the cold, and carbon dioxide would turn solid, which is why, according to Professor Hoyle, Uranus and Neptune seem to be made of precisely those materials. Towards the centre of the disc, magnesium oxide, silica and iron would have condensed and so we find that the inner planets, especially Venus and the Earth, contain most of the iron in the solar system.



Saturn seen through the Mt. Wilson 100 in telescope

The theory also explains something which used to puzzle astronomers, namely, why is nearly all the iron in the Earth in the middle? If the Earth was cold when it was formed, then the iron would have been hard and solid and as Professor Hoyle points out, it is difficult to understand how that iron could have managed to sink through to the centre. But if the iron was collecting at a high temperature, in a semi-molten plastic state, then it is much easier to understand how it flowed into the middle. We still have to explain how the hot Earth managed to collect volatile compounds and gases, such as water, carbon dioxide and nitrogen. According to Hoyle, this happened later. As the cloud of gas finished its contraction into the Sun we know today, the Earth and the other planets around would have cooled and "mopped up" any debris. ("Spectrum," No. 50.) ■

They **CLIP IN** and stay put: **'Lock-fit' Transistors** *from* **Mullard**



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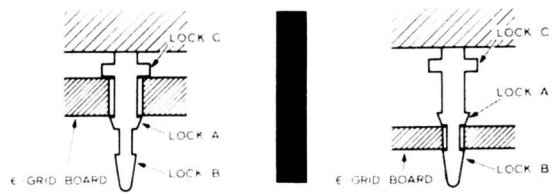

These diagrams show details of 'lock-fit' pins and function of three 'locks' when used with E-grid and the more closely spaced E-grid printed wiring boards.

LOCKFIT TYPE	EQUIV. METAL TYPE	DESCRIPTION	V CEO (V)	I CM (mA)	P_{tot} at 25°C (mW)	h_{fe} or h_{FE}*	at I_C (mA)	SPECIAL FEATURES
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BC148	BC108	AF n-p-n	20	200	220	125-900	2.0	Typ. N.F. 2.0dB
BC149	BC109	Low Noise n-p-n	20	200	220	240-900	2.0	Typ. N.F. 1.8dB
BC157	BC177	G.P. p-n-p	45	200	220	75-260	2.0	
BC158	BC178	AF p-n-p	25	200	220	75-500	2.0	
BC159	BC179	Low Noise p-n-p	20	200	220	125-500	2.0	Typ. N.F. 2.0dB
BF194	BF184	Mixer Osc. n-p-n	20	30	220	115*	1.0	Typ. N.F. 2.0dB
BF195	BF185	IF Amp. n-p-n	20	30	220	67*	1.0	Typ. N.F. 3.5dB

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PULSE CODE MODULATION TV

. . . BBC research shows promise

In the U.K., engineers of the British Broadcasting Corporation have been experimenting with a system of pulse code modulation for broadcast television. The results obtained so far have been very encouraging.

The electrical signal which contains all the information needed by a television receiver to reconstruct picture and sound is exceedingly complex—particularly when information about colour, as well as brightness, is present. Because of the large amount of information crammed into the signal, changes in brightness, colour and the like are often represented by only subtle changes in the signal, and are consequently all too easily affected by small disturbances.

For these reasons, transmission routes have to be continually checked by skilled engineers so that any necessary corrections can be made. Also, the processing operations which have to be applied to the signal, such as mixing and fading, coding of colour signals and standards conversion, call for complex equipment.

Television engineers have known for a long time that many of these problems could be overcome by using digital techniques. When information is transmitted in the form of a series of pulses, the only requirement at the ultimate destination is the presence of a pulse. For data-processing operations, transmission characteristics of the route over which the signal has travelled have relatively little significance; the shape of the pulse can be changed considerably before it becomes unrecognisable as a pulse. For data-processing operations, digital techniques are now generally accepted as the best approach.

Such arguments apply to telephone channels, and the British Post Office has already said that one digital technique — binary pulse code modulation (PCM) — will be the basis for future telephone network design. Although PCM techniques have been known for some time, only recently, with the development of reliable, high-speed semiconductor devices, have such methods been a practical proposition. By the same token, TV has had to wait until now.

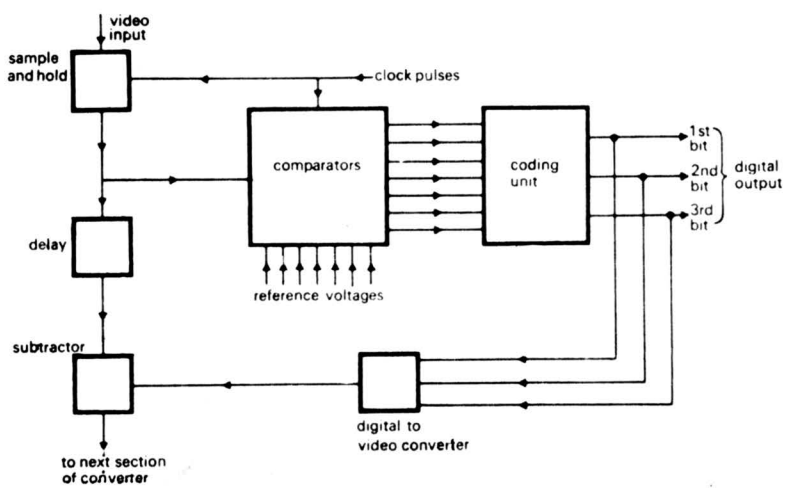
Working in the B.B.C. research department, V. G. Devereux and E. R. Rout have recently developed equipment to convert television signals from analogue to binary PCM form.

Using the PCM technique, a signal is "sampled" at regular intervals, and its value converted into a series of pulses representing a binary code. The rate of sampling needs to be about twice the bandwidth of the signal in theory, but practical considerations raise this about 20 per cent. The 625-line television signal (5.5MHz) needs therefore to be sampled about 13 million times a second.

The number of pulses required per sample — the "bit rate" — obviously determines the number of values which can be coded. The B.B.C. workers have shown that seven or eight bits per sample are required for a high quality television signal, allowing quantising of the signal into 128 or 256 levels.

With four bits, giving 16 brightness levels in the final picture, obvious distortion occurs. With six bits, as in a prototype equipment already built, the 64 allowable brightness levels make any such effects difficult to detect, except in some critical scenes.

The equipment consists of two parallel types of converter in series, the first determining the three most significant binary digits, and the second, the three least significant digits. After coding, the three most significant digits are reconverted to analogue form and subtracted from the original signal, the result being fed to a second converter. ("Engineering," Mar. 18 1968.) ■



The converter built by BBC research engineers, for 6-bit coding, is of serial-parallel design. The three most signicant digits are extracted by a parallel converter, in series with another for the three least significant digits.

Sections of two monitor pictures showing the results obtained with PCM systems using a four bit code quantised into 16 brightness levels (left) and a six bit code giving 64 quantised levels. (Because of limitations in the printing process, the tonal distortions in the left hand picture may not be as evident as in the original photograph.)

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E897

PROGRESS WITH ELECTRONIC AIDS FOR THE DISABLED

Electronic devices to assist blind and disabled persons are numerous, and have been reported on many occasions in this magazine. Nevertheless, some recent developments in this field show such rapid progress that we make no apologies for presenting the two stories below.

Perhaps the most startling development to date is an attempt to provide artificial sight for blind persons, described in the July 11, 1968, issue of "New Scientist":

Experiments carried out in Cambridge which have enabled a blind woman to receive visual information fed directly into her brain are said to indicate that it may eventually be possible for blind people to avoid obstacles when walking and to read print and handwriting at almost normal speeds. Writing in the May issue of the "Journal of Physiology," G. S. Brindley and W. S. Lewin, of Cambridge University and the United Cambridge Hospitals, describe how they used an electrode sheet inserted inside the skull. The electrodes made contact with the surface of the visual cortex and gave the patient the sensations of seeing light when they were electrically energised. Eighty electrodes were each connected to coils incapsulated in a sheet of silicon rubber under the skin. The electrodes were excited by transmitting coils placed on the scalp directly above the electrode coils.

These experiments, although very crude, may, like similar ones carried out elsewhere, lead in the very distant future to the only real solution to the problem of blindness. It is true that very encouraging results have been achieved with devices such as Professor Kay's ultrasonic torch (see "Eyes for the Blind," "Electronics Australia," Feb., 1966); but these devices offer only a very limited solution to the problem. Like the white cane, they help the blind man find his way round, but they can in no way be thought of as a replacement for the natural sight he has lost. Providing a real substitute for sight almost certainly means finding a way of getting electrical signals directly into the brain and preferably of making as much use as possible of the brain's highly effective data-processing systems. It is unlikely that this can be done by way of the ear or any of the sense organs. The information to be handled is enormous. The optic nerve, for example, is believed to be a bundle of about one million paths and the visual data are not stored, but are processed on line — an incredibly complex operation, far beyond that of any of today's computers.

One of the workers in this field, Professor Armando del Campo, of the National University of Mexico, has been experimenting with a series of photosensitive elements that convert images into complex electrical signals, which are introduced into the brain through the tri-geminal nerve, the fifth cranial nerve, and produce a series of sensations in black, grey and white. He says that a blind person can move round in a satisfactory manner, avoiding trees, lamp posts, ground obstacles etc., and can find objects on a table from the amount of light they reflect. Light sources and bright things are easy to find.

No useful information could be given to Dr Brindley's patient, but when signals of appropriate strength and frequency were applied she experienced sensations of light at various positions in the visual field. Sensations produced by two electrodes one tenth of an inch apart could be distinguished, which suggests that enough electrodes could be emplanted to enable a patient to discriminate patterns. Six hundred electrodes activated by an automatic page scanner should, according to Dr Brindley, allow a person to achieve normal reading speeds. Clearly there is a very, very long way to go yet; but, as del Campo has said corticogenic vision as it is called, may not be quite the far fetched idea it once was.

An advanced system designed to enable disabled persons to undertake a range of everyday tasks, including typing, is described in the May, 1968 issue of "Design." While the light beam/photocell system used is not new, the availability of the equipment as a manufactured item represents a significant step in the rehabilitation of disabled persons. A feature of the equipment is its versatility, which enables further functions to be performed by the addition of modules. The report says:

The device, known as the PILOT (Patient Initiated Light Operated Telecontrol) system has been developed by Hugh Steeper Ltd. of Roehampton, U.K. Basically, it consists of light-sensitive cells which, when triggered off by a light beam, will activate any electric appliance or any facility (like opening and shutting curtains) that can be electrically operated. In this way, even tetraplegics and quadraplegics can be given a considerable amount of environmental control without having to exert much effort or undergo any extensive training. They do not, for example, have to suck and blow, nor do they have to learn a complicated code. All that is needed is the ability to move the head (or another part of the body) five degrees.

The Pilot system was developed originally for use with a Facit electric typewriter, when a frame of electric cells representing the normal symbols found on a typewriter keyboard is placed in a convenient position in front of the disabled person. The frame can also give additional instructions — uppercase or lowercase letters, return of the carriage, margin indenting and so on—which are then fed straight into the typewriter. Activating the frame, and hence the typewriter itself, is done by a light beam source attached to the person's head or body, and even when it is attached to the head, it has been found that a disabled person can become proficient at typing speeds of 30-40 words a minute in a comparatively short time.

PILOT in use, showing how the light beam can be controlled by slight movements of the head.

The system is, in fact, designed on a modular basis, modules being added to the basic power unit to meet the requirements of each individual. Each module contains an on/off control, so that the range of activities (quite apart from using the typewriter) can easily be increased from, for example, opening and closing curtains, which requires one module plus the power unit, to controlling a television set, in which two further modules are all that is required to switch on and off, select a channel, and control volume, brightness and contrast. In all cases, only a small modification to the equipment is needed and a wide range of equipment can be controlled in this way. ■

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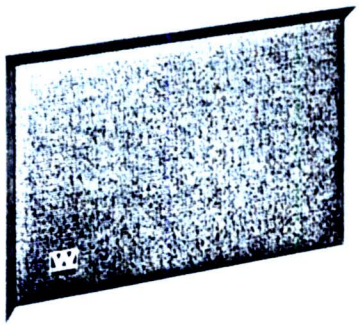

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SCIENTIFIC AND INDUSTRIAL NEWS

Space debris calculations

Dr J. W. Morgan, of the Australian Atomic Energy Commission, has estimated the amount of extraterrestrial material in a bed of shale at Etheridge Creek, in northern Queensland. The shale is composed of hardened layers of sediment laid down from about 420 million to 400 million years ago. Analysis suggests that 8,000 tons of space debris was reaching the surface of the earth every day at the time the rock was being formed. Similar amounts are thought to reach the earth today, indicating the rate of arrival has remained fairly constant over the past 400 million years.

Extraterrestrial material usually contains chemical elements in different proportions from those naturally occurring on earth. Samples of the shale were analysed by neutron activation analysis, which allows chemical isotopes to be identified in quantities of less than a millionth of a microgram. Samples are made radioactive by bombardment with neutrons: each isotope then emits characteristic radioactivity, measurement of which allows its quantity to be estimated.

Translator station opened

A National Television translator station at Townsville began regular transmission on Monday, July 15. The station is designed to serve the North Ward and its immediate areas which did not receive a satisfactory service from the high powered station at Stuart owing to the signals being shaded by Castle Hill. The new station transmits on channel 10 and takes its programs on relay from channel 3. The power output is five watts and the station operates on horizontal polarisation.

Malaysian contract

Standard Telephones and Cables Pty. Ltd. has won a three-year contract to supply Malaysia with low-capacity radio link systems to extend the country's existing trunk line telephone and telegraph networks. The initial order under the terms of the contract is worth $700,000 and the overall value of the contract, when completed, should exceed $2-million. According to the Department of Trade, it is the biggest export contract with Malaysia ever signed by an Australian company.

Transmitters for Radio Hong Kong

Two new 20KW radio transmitters, supplied and installed by Standard Telephones and Cables Pty. Ltd., have been taken into service for the Chinese and English services of Radio Hong Kong. Each transmitter consists of two complete 10KW units, coupled together with a combining unit to provide uninterrupted broadcasting in the event of a fault developing in one. They were specially designed for the high temperature and humidity conditions encountered in Hong Kong. The 300-foot aerial mast has been built to withstand typhoon wind gusts of up to 200mph.

The two transmitters work with the same aerial and provision has been made to install a third transmitter at some future date if required. Both feed into the aerial through high power filter circuits to prevent interference. Each transmitter uses only two types of valve in the final stages, the low power stages are fully transistorised, and the high tension power supply uses silicon diodes instead of valves.

New memory element

Scientists of the Lockheed Missile and Space's Company's Research Laboratory, Palo Alto, California, U.S.A., have produced a gadolinium iron garnet (GdIG) memory element with a capacity of one million storage spaces per square inch. The memory features random access, non-destructive readout, and selective erasing and rewriting. At a million bits per square inch, packaging density approaches the resolution limit of the wafer as given by grain size.

The initial state of magnetisation of the GdIG wafer can be reversed for any one of the tiny portions of the wafer by temporarily increasing the local temperature with an accurately directed laser or electron beam. To read a recorded bit out of the memory, a light beam of lower intensity is used. This beam's characteristics are affected one way by untreated spots and another way by the spots with reversed magnetisation.

DCA communication expansion

The Department of Civil Aviation is steadily increasing its purchases of telecommunications and ancillary services. Nearly $5 million has been allocated for such projects this year compared with $4.5 million last year. Much of the equipment is being supplied by member companies of the Australian Telecommunications Development Association.

The department is continuing its policy of expanding VHF point-to-point circuits and air-ground-air communication networks. Plans are also in hand to improve the quality of HF long distance radio telephone circuits and ground-to-air transmissions. More navigational aids are being provided and plans to introduce a 100W transistorised MF non-directional beacon are well advanced. The standard 200MHz distance measuring equipment (DME) is being developed in an all-transistor version to enable further expansion of this type of facility. Plans to purchase fully transistorised VHF omnirange (VOR) equipment are also in hand.

MOST microcircuit service

The Plessey Pacific research and development laboratory at Richmond, Victoria, is now offering a complete design and manufacturing service for MOST microcircuits. The laboratory is directed by Dr W. A. S. Butement, C.B.E., director of research for the group. It is hoped that scientists from the Government and the universities will eventually be invited to spend some time at the laboratory for interchanges of information.

Mr I. Buxton, U.K. "Technical Student of the Year," is shown a power converter by Mr N. Brinsden (engineer in charge of carrier telephone development and production) at Philips Telecommunications factory, where he is working during his stay in Adelaide. Mr Buxton, a British Post Office telecommunications technician, will move around Australia and work in many Government and private organisations during his six months' stay in this country.

ADCOLA

"M" SERIES

AUSTRALIA'S LEADER IN MODERN PRECISION SOLDERING TOOLS

SELECTED AS **Good Design** FOR AUSTRALIAN DESIGN INDEX
INDUSTRIAL DESIGN COUNCIL OF AUSTRALIA

M70 Tip Shaft Dia: 1/8" Rating: 19 watts Weight:* 3 ozs.
Application: Transistor, miniature and micro-miniature electronics and instrument work.

M64 Tip Shaft Dia: 3/16" Rating: 23 watts Weight:* 3½ ozs.
Application: Standard tool for radio and television assembly and servicing.

M107 Tip Shaft Dia: 1/4" Rating: 27 watts Weight:* 4 ozs.
Application: Servicing in telecommunication centres and similar heavier tagging.

*Weight of tool only, without cord set.

M150 Tip Shaft Dia: 5/16" Rating: 45 watts Weight:* 6 ozs.
Application: General Purpose Solder Tool, sheet metal, earthing strips and other heavy duty work. Tip incorporates unique anti-seizing ferrule

LONG LIFE TOOLS, TESTED AND PROVED IN WORLD-WIDE SERVICE.

Adcola "M" Series soldering tools are long-life precision-made tools, the result of 20 years' development to meet the particular needs of the Communications and Electronics industries throughout the world.
They are standard equipment in all Australian Armed Services, Space Tracking establishments, P.M.G.'s Department, major computer firms and numerous other organisations with the resources to carry out stringent comparative pre-selection tests on soldering equipment.

GREATER THERMAL EFFICIENCY

The advanced design reduces heat losses to a minimum and provides a work capacity in each model normally associated with conventionally designed tools of twice the rated power. Initial heat-up time (60 seconds for M70, 100 seconds for M64) and heat recovery are extremely rapid. Elements are calibrated to provide optimum tip temperatures for swift and sound soldering of terminations in each type of circuit.

DESIGNED FOR ACCURATE SOLDERING

The lightness and balance of the "M" Series tool; the flared handle, ribbed for a positive precision finger grip; the slim heater unit allowing the best possible visibility and penetration; the combination of these design features allows easy, precise manipulation and therefore better soldering.

INSTANT CONTROLLED HEAT

A constant heat tool operating at the correct soldering temperature ensures the swiftest and most efficient soldering. Poor quality soldered joints caused by too high or too low a soldering temperature are avoided. Fitted with a hook for suspension while idling, Adcola soldering tools will operate continuously without risk of overheating or loss of tip tinning. Heat sinks, idling or cut-off switches are **NOT** required.

EASY REMOVAL OF TIP

The tip is held firmly by a stainless steel collet, and is easily removed for cleaning and replacement and to allow quick fitting of special-purpose tips.

SAFETY FIRST

Safety was a primary consideration in the design of the "M" Series, which embodies a fully insulated element and a double-earthed helical wire outer casing to the heater unit. Every heater unit must pass an insulation test of 2,000 volts before release from the factory.

NO TRANSFORMER REQUIRED

Adcola tools conform to S.A.A. approval and test specifications and are approved in all States for mains voltage operation.

All models are available for 230-250V, 200-220V, 100-120V, 50-55V, 32V, 24V, 12V and 6V.

ADCOLA PRODUCTS PTY. LIMITED

12 CHURCHILL STREET, MONT ALBERT, MELBOURNE, 3127, VIC., 88-4351

N.S.W.: ADCOLA PRODUCTS PTY. LTD., 17 BURWOOD ROAD, BURWOOD, N.S.W. 747-1606.
S.A.: F. R. MAYFIELD PTY. LTD., 11 HALIFAX STREET, ADELAIDE. TEL.: 8-4131.
QLD.: T. H. MARTIN PTY. LTD., 56-74 EDWARD STREET, BRISBANE. TEL.: 2-0555.
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N.S.W.: H. ROWE & CO. PTY. LTD., 512 PUNCHBOWL ROAD, LAKEMBA, 750-0333; GEORGE BROWN & CO. PTY. LTD., 29-5877; BROADWAY ELECTRONICS PTY. LTD., 211-4224; ELECTRONICS PARTS PTY. LTD., 533-1277; GENERAL ACCESSORIES PTY. LTD., 73-0211; GEORGE KENT (AUSTRALIA) PTY. LTD., 525-2811; MARTIN DE LAUNAY PTY. LTD., 29-5834; NEWCASTLE, 84741; WAGGA, 4644; WOLLONGONG, 86020; LAWRENCE & HANSON ELECTRICAL PTY. LTD., 69-4041; NEWCASTLE, 61-5573; WAGGA, 4224; PAUL'S (MERCHANTS) PTY. LTD., 61-6392; RADIO DESPATCH SERVICE, 211-0191; REG ROSE & CO. PTY. LTD., 29-1851; W. G. WATSON & CO. PTY. LTD., 29-5631; NEWCASTLE, 61-4961.
VIC.: A.E.I. PTY. LTD., 34-0471; ELECTRONICS DEVELOPMENTS PTY. LTD., 63-3596; GENERAL ACCESSORIES PTY. LTD., 69-0300; HOMECRAFTS PTY. LTD., 32-3711; J. H. MAGRATH CO., 32-3731; RADIO PARTS PTY. LTD., 30-1251, 211-5921; WARBURTON FRANKI (MELB.) PTY. LTD., 69-0151.
QLD.: BATTEN'S ELECTRICAL PTY. LTD., 5-3936; SOUTHPORT, 2-1685; CHANDLERS PTY. LTD., 31-0341; JAMES CROKER & SONS, MACKAY; A. E. HARROLD PTY. LTD., 31-3081; LAWCAIRNS, 3739; TOOWOOMBA, T'VILLE; GENERAL ACCESSORIES PTY. LTD., 2-3093; B. MARTIN PTY. LTD., CAIRNS, INNISFALL; C.A. PEARCE & CO. PTY. LTD., 2-3201; TRACKSON BROTHERS PTY. LTD., 2-2804; WYPER BROTHERS LTD., 5-3219, BUNDABERG; WARBURTON FRANKI (BRISBANE) PTY. LTD., 51-5121.
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W.A.: ATKINS (W.A.) LTD., 21-0101; GENERAL ACCESSORIES PTY. LTD., 21-2501; CARLYLE & CO. (1959) PTY. LTD., 21-9331.
N.T.: LAWRENCE & HANSON ELECTRICAL (N.T.) PTY. LTD., DARWIN, 3732.

Data system for RAN

Plessey Automation and Electronics has delivered a salinity, temperature, depth (STD) data acquisition system to the Royal Australian Navy experimental laboratory in Sydney. The system is an integrated, seaworthy assembly of sensors, recorders and associated equipment for obtaining accurate and continuous profiles of basic ocean properties. Salinity, temperature and (optionally) sound velocity are presented as functions of depth.

Data is continuously acquired by high precision sensors, which are physically and electrically integrated as a multi-parameter, in-situ sensing system housed in an underwater "fish." All underwater elements of the system are suitable for deep-sea operation, being tested to 12500 psi. The system is marketed in Australia under licence from the Bissett-Berman Corporation of America.

More efficient training

The use of dictation machines for instructing trainee plant operatives in the assembly of electronic equipment has resulted in increased efficiency and output at the Hendon, S.A., factory of Philips Electrical Pty. Ltd. Programmed instruction with dictation machines has enabled workers to learn their task 30 per cent faster, and make 40 to 50 per cent fewer errors during the initial run-in period even while engaged on assembling the most complex equipment.

Automatic proving equipment

An automatic proving and changeover unit is included in the radio telephone system used for the Ord River irrigation scheme (See "Scientific News", August, 1968). The complete radio telephone system was designed and installed by Philips Telecommunications. At regular intervals of one minute, a control timer in the unit feeds a changeover (to the duplicate set) command into a delay circuit and, simultaneously, initiates tests on the radio equipment. If the station passes the tests, the unit stops the changeover command in time, and rests until the next one-minute period. If the radio station fails any part of the test, the command is allowed to continue and a changeover effected. The main station is closed down, the standby station is activated and normal operation is continued—including the continuous proving cycle.

Delay line glass

A fully automatic, continuous pressing process for colour television delay line glass has been developed by Chance-Pilkington, specialist glass manufacturers of Glascoed Road, St. Asaph, Flintshire, Wales. The process is operated on a manufacturing line which takes molten glass from a melting tank and presses gobs into shape on a rotating table using new tooling to press the complex shape at high speeds. A new raw material composition has also been developed which eliminates the need for the glass to be stored before it can be used as a component in colour television receiver production.

Colour TV delay line glass on a production line at Chance-Pilkington.

RF soldering

RF soldering is being used at the Letchworth, U.K., factory of I.C.T. Ltd., in the production of their new range on IC computers, reports "Electronics Weekly." The pin to be soldered and a preformed solder washer are heated by a rapidly alternating magnetic field. As the joint does not come into contact with the heating element a clean joint is ensured. The heating element is a water-cooled copper coil (which does not itself get hot) through which an RF current is passed for a short period.

The method is being used to connect back-wiring pins in multi-layer boards to the respective earth and power planes. Each panel is clamped in a movable table, under which is a perspex template. This has holes corresponding to the positions of the pins to be soldered in each plane. As the operator moves the table, a spigot comes into contact with each hole and initiates the soldering cycle. As each cycle is triggered, the coil heats up automatically for a set time and is then lowered on to the pin. A complete soldering cycle lasts only 4½ seconds.

Computer data entry units

Companion units that enable a keyboard operator to record information on magnetic tape and then enter it automatically into a System/360 computer were announced recently by IBM Australia Ltd. The units are designed to help users to get information into their computers more effectively where punched cards are not required as a record. The operator at the IBM 50 magnetic data inscriber console (left foreground) types information on the keyboard to record it on magnetic tape housed in a small plastic cartridge. The cartridge is then placed in its companion unit, the IBM 2495 tape cartridge reader (right), which automatically feeds the information into computer storage at 900 characters a second. Up to 12 cartridges can be placed in the reader at the same time and read automatically.

International patents scheme

An international organisation is currently engaged in finding a way to simplify patenting inventions in a number of countries, according to a news item in "Wireless World." The organisation, located in Geneva with more than 80 member countries, is called the Bureaux Internationaux Reunis pour la Protection de la Propriete Intellectuelle (BIRPI). BIRPI will not issue international patents; this will be the responsibility of the national patents offices. It is hoped that the idea will avoid duplication of effort in member countries and prevent time-wasting for the patents offices and inventors.

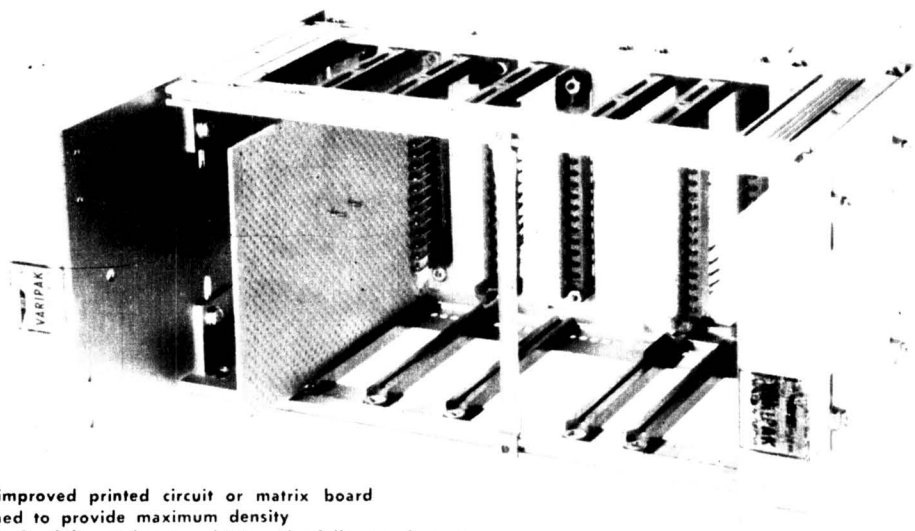
Measuring trunk line loading

A metering device capable of accurately measuring the loading on telephone trunk lines has been developed by a Sydney company, Master Instruments Pty. Ltd. Known as the Erlang Meter, the instrument is expected to interest overseas telephone communication companies and authorities where measurement of loading is an essential prerequisite to forward planning of trunk lines and cables. Master Instruments' meter has been ordered by the P.M.G.'s Department and the equipment will be in use in all Australian telephone exchanges shortly. It will provide information which can be used by the department in computer planning for extension of telephone services.

ELCO

NEW VERSATILITY VARIPAK II

PRINTED CIRCUIT CARD ENCLOSURE



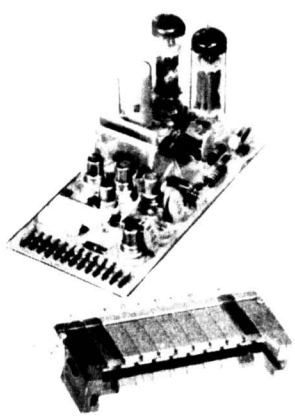
VARIPAK II is our improved printed circuit or matrix board card enclosure designed to provide maximum density coupled with complete flexibility. It has, in addition, the following features:

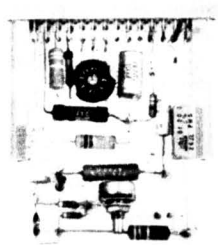
1. Simplicity of Card Guide design offers greater strength.
2. Guides can be easily inserted into Guide Plate and also quickly removed from any position without damage to either the Guide or the Guide Plate.
3. Card Guides have sufficient float to allow for any tolerance accumulation between the Card Guide and connectors.
4. Guide Plate fabrication from extruded aluminium provides a much stronger unit.
5. Connector Panel is assembled with machine screws and nuts rather than self-tapping sheet metal screws.
6. Sixteen standard sizes covering a wide range of printed circuit card sizes are available.
7. Special sizes can be provided with little or no tooling charges.

DUAL PURPOSE MODULE ENCLOSURE

PRINTED CIRCUIT **OR** MATRIX CARD

The Elco 5002/4 Series Printed Circuit Connectors shown with a printed circuit board is unique in its design and flexibility. The actual connection is made by a male contact attached to the P.C. board by a simple staking operation. This ensures a degree of reliability which cannot be obtained by the old method of connection. This method relied on the foil of the P.C. board for the actual male contact and unlike the ELCO contact, did not provide the gold surface now considered almost essential by experienced circuit engineers.
The connector itself is made from individual modules and can be readily altered if this becomes necessary at some later date.





An ELCO 5023 Series Printed Circuit Connector with a Vector-Board Type 837BWE epoxy glass matrix board is an ideal combination for prototypes. The strong board will withstand even the most rugged handling and can be drilled or punched for mounting components with no danger of cracking or breaking.
Elco contacts may be quickly staked to the board, if required and by using the special MINI-KLIP terminals for component mounting, the board may be wired in the same actual layout which will be used when a printed or etched circuit module is made. This means that even in the very early prototype stage the circuit can have all the advantages of plug-in facilities.

Elco (Australasia) Pty. Limited
(A subsidiary of International Resistance Holdings Limited)
The Crescent, Kingsgrove, N.S.W.
Telephone: 50 0111

POST TODAY for information

☐ Varipak card enclosure ☐ Vector matrix boards
☐ Elco plugs and sockets

NAME .....

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Acoustics meeting in Sydney.

An international Acoustics Symposium, organised by the Australian Acoustical Society, is to be held at the Wentworth Hotel, Sydney, on Monday and Tuesday, September 9-10, 1968. This Symposium follows the 6th International Acoustics Congress held in Tokyo in August, and papers will be presented by several overseas speakers, including Dr D. Hodge, of the U.S. Army Human Engineering Laboratories. Other papers will be presented by interstate and N.S.W. specialists in the subject.

The topics to be discussed are in the fields of psycho-acoustics, noise suppression and architectural acoustics. Papers will be presented on such diverse topics as the effects of noise on hearing, aircraft and traffic noise, noise in offices, the acoustic design of television studios and the use of models in the design of auditoriums. The society says these topics should prove to be of interest to engineers and architects as well as to psychologists and specialists in the field of acoustics.

Registration forms, programs and any additional information required, can be obtained by writing to the Secretary, Australian Acoustical Society, P.O. Box 80, Crow's Nest, N.S.W 2065.

Ministerial visit

The Minister for Supply, Senator K. Anderson, and the Secretary of the Department, Mr A. S. Cooley, recently visited the AWA works at North Ryde, a Sydney suburb. The Minister, second from right, examines a section of the AWA lightweight militar radio communication pack-set while company engineer, Mr J. Barrett (extreme right) explains the equipment. Mr Cooley, alongside Senator Anderson, and Mr J. Gilchrist, AWA engineer, looks on.

Radio telephone development

A new type of terminal equipment—developed by the British Post Office to improve the quality and efficiency of HF radio telephone circuits—has proved so successful in operation that it is to be extended to a number of important overseas services. The new equipment, known as Lincompex, enables maximum use to be made of any available circuit by ensuring a high transmitter modulation percentage at all times. The result is a very significant reduction in noise and improvement in intelligibility.

In the Lincompex system the signal is compressed at the transmitter. Details of the amount of compression are introduced as a control signal in a 300Hz channel in the audio band. The amount of expansion necessary at the receiver to reconstitute the signal in its original form is determined by this control signal. The system makes full use of the available power from the transmitter and gives a consequent improvement in the signal-to-noise ratio.

Automated message station

A fully automated message relay station developed by Standard Telephones and Cables Ltd., U.K., has been adapted to the special requirements of the Royal Australian Corps of Signals. It is called STRAD for Signal Transmitting, Receiving and Automatic Distribution. Fully transistorised, STRAD uses techniques similar to those used in computers and data processing devices. Without manual aid it can receive, identify and re-transmit a thousand messages in a few minutes and automatically groups classifications into secret and other categories.

The heart of the system is duplicated and operates with a no-break power supply system which takes over automatically in the event of a power failure. If a fault develops, STRAD sounds an alarm to indicate a failure. It switches in a spare unit and then under the guidance of an engineer it finds its own fault using a part of itself called the Routiner. A prepared program is fed into the machine to indicate the faulty part. This is then unplugged by the engineer and replaced.

A magnetic memory system controls its operation and stores the messages before re-transmission. Each message as it enters STRAD is passed to a central message store. From there the destination of the message is processed automatically, the system checking that the destination is free to receive the message. If it is not, then the message is either stored temporarily or routed by an alternative path. If the number of messages gets too high, an alarm is sounded and the supervisor puts the backlog of messages on magnetic tape. When the destination point is cleared, the stored messages are sent in rapid succession.

Computerised power station

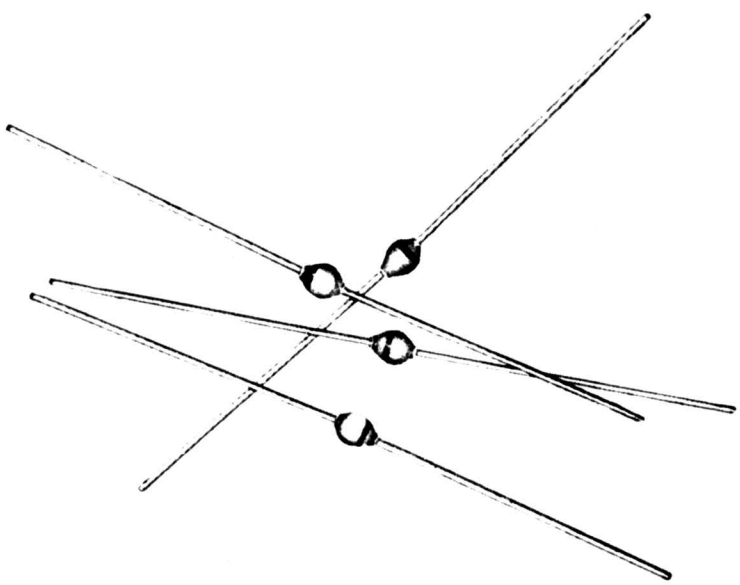
The second of four computer based control systems ordered for the 2000 megawatt Fawley power station in Britain was delivered early this year. Fawley will be Europe's largest power station to have all the major items of plant under computer control. The first control system went to Fawley in May, 1967, and is now being used to commission the first boiler/turbine unit as it is completed. The remaining two systems will be completed by May, 1969.

Each of the 500 megawatt turbo-generators with their associated equipment will have a separate control scheme based on an English Electric KDF7 computer, and including scanners, printers, punched tape and readers as well as tabular displays to give the operator data on any part of the station. On instruction from the operator, the Fawley system will automatically prepare the turbo-generators for run up to speed, load the machines, monitor their performance while operating, and automatically shut them down. An auto-code has been developed to make it very simple for the operating staff to write and understand control programs.

Checking noise

The reigning British "Queen of the Road," 20-year-old Beverley Flanagan, of South London, sits astride a 125cc scooter during demonstrations of a vehicle noise meter held recently at the Brands Hatch racing circuit in Kent. The meter, manufactured by Dawe Instruments Ltd., has been specifically designed to meet new laws introduced making all motor vehicles subject to spot checks on the road to ensure that they are not making more noise than the new standards allow.

New Ideas in Electronics



A 1.0-amp rectifier that dissipates 1000w in reverse direction without heat damage

The General Electric A14's ability to dissipate up to 1000 watts in reverse direction without heat damage means there is no worry of surface breakdown during absorption of household and industrial voltage transients.

Securely sandwiched between two heavy thermally-matched slugs, the 1.0-amp A14 pellet is protected from transient voltage heat. Its PN junction goes into reverse power safely throughout the bulk of the silicon pellet and preventing localized heating at the perimeter. You get high surge current capability and low thermal impedance, too.

Additional product features include:

- *Reverse power handling capability of 1000 watts for 20 microseconds
- *Peak surge forward current of 50 Amperes for 8.3 milliseconds
- *Dual heat sink design
- *Hermetically sealed package

The glass-encapsulated A14 rectifier is ideal for time delay circuits, power logic circuits, arc suppression, battery chargers, general purpose power supplies, TV, radio, and other communication equipment.

For more information on how to make the A14 work for you, write Australian General Electric Pty. Ltd., 103 York Street, Sydney, N.S.W. 2000. Telephone 29 8711; or 552 Lonsdale Street, Melbourne, Victoria 3000. Telephone 67 8221.

GENERAL ELECTRIC*

*TRADE MARK OF GENERAL ELECTRIC COMPANY, U.S.A. — WORLD'S LARGEST ELECTRICAL ENTERPRISE

40-16QQ

Mallard research study

The Space and Instrumentation Group of British Aircraft Corporation Ltd., Bristol, England, has been awarded a contract to develop a technique for the study of the electromagnetic compatibility of alternative designs of the Mallard communication system. Mallard is to be a tactical communication system in which the U.K., the U.S.A., Canada and Australia plan to build a common battlefield radio communication system from 1975-77. Mallard will link the services of the four nations, transmitting information by voice, teletypewriter, facsimile and digital data.

The BAC research study involves the writing of a computer program which will be used as a model of the complete Mallard system to aid designers in their selection of the most suitable equipment and its deployment. The computers will simulate the transmitters, aerials and receivers used in the system, as well as the effect of rain, trees and vehicle movement on the quality of transmitted information.

Disappearing bottles

Rigello Pak AB, a Swedish company, has produced a cylindrical container with a cone-shaped top which could replace non-returnable bottles, says a report in "New Scientist," 11/7/68. It is made of rigid PVC for strength and low gas permeability, Saran (polynylidene chloride) to improve gas tightness, and a paper sleeve lined with aluminium foil and plastic glue. The new container weighs only a tenth of its glass counterpart, and the makers claim it can withstand the varying pressures of storage and transport. When the container is thrown away, the paper disintegrates and rots, and the plastic is decomposed by sunlight and acids in the soil. The bottle can also be burned.

Portable TV training unit

At the recent NAVEX exhibition in London, The Marconi Company, of Chelmsford, Essex, exhibited for the first time an extremely portable television unit. It enables television training programs to be recorded on the spot anywhere in a factory or educational establishment by using equipment mounted in two wheeled units. The complete system can be packed up, moved from one location to another, and set up again very quickly. One of the units, a miniature producer's console, breaks down into three sections for improved portability.

In its basic form, the system includes two portable consoles — one containing the sound and vision control equipment, the other carrying the preview monitors and videotape recorder — two cameras and a 23in display monitor. Additional cameras and other facilities can be added to cater for a specific user's need.

Measuring RF power

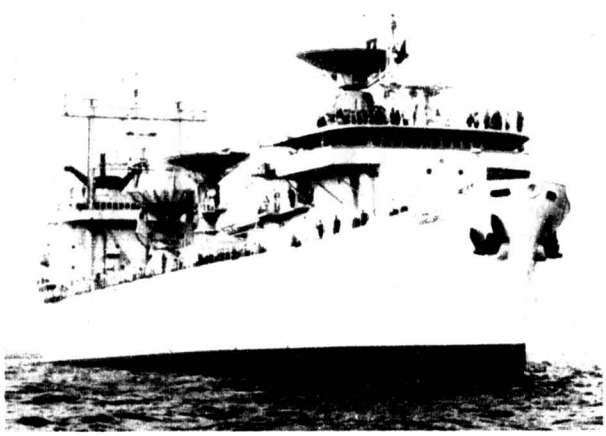
Research at the National Bureau of Standards of the U.S.A. to meet demands for increased accuracy in the measurement of RF power has resulted in the development of a new dual dry-load calorimeter. This incorporates an automatically controlled reference DC input power as an accurate means of measuring RF power. The new calorimeter, developed by M.L. Crawford of the N.B.S. Radio Standards Laboratory, is a significant advance over existing types in that it provides a power range of 10mW to 1W at a working frequency up to 4GHz with a maximum uncertainty of less than 0.35 per cent.

Audio information retrieval

A true random access audio information retrieval system has been installed by Ampex Corporation at the Oak Park and River Forest High School, Oak Park, Illinois, U.S.A. When fully programmed, the system will permit students to receive any one of 224 recorded 15-minute lessons in less than 30 seconds. Maximum waiting time under any conditions is 59 seconds. The installation is the first step of a scheduled three-phase instructional research centre — future phases will extend the system to include video instructional material and provide additional student access points.

At the heart of the system are seven master tape transports, each with 32 tracks carrying a complete 15-minute lesson on each track. Programs are transferred from the master unit to the student buffer unit at 120 ips and replayed for the student at 3 ips. The high speed transport can transfer a program to any number of student buffers simultaneously. Further information can be obtained from Ampex Australia Pty. Ltd., N.R.M.A. House, North Sydney, 2060. ■

Moonfleet control ship



USNS Vanguard (T-AGM 19), one of five U.S. Naval ships designed to serve as seaborne control and communications stations for the NASA Apollo mission.

SECONDARY BATTERIES — Part Two
Their Construction and Characteristics

This is the second article describing various secondary battery types. It covers the sealed lead-acid, the calcium-lead version of the lead-acid, the nickel-iron, and nickel-cadmium. As with the lead-acid types, there are a number of variations within the basic chemical structure of the two latter types.

By Charles H. Carr*

MAINTENANCE-FREE BATTERIES: The familiar lead-acid battery has been converted into a versatile and economical high-power source for many portable electrical devices, such as tools, television sets, lanterns, home appliances and toys. To achieve this it has been completely redesigned. It is as light and compact as possible, it is sealed against leakage of acid and gases, and it requires no maintenance except recharging.

Although it is more powerful than most "in-the-handle" batteries and is capable of operating longer on one charge, the new battery is much less expensive than nickel-cadmium units.

Sealing of lead-acid batteries, first successfully achieved in 1962, gives the new units the combined advantages of high power and rechargeability characteristic of wet-cell batteries, and the handling ease of dry-cell batteries. Previously it was necessary to provide ventilation by means of openings in the filler caps or covers of lead-acid batteries.

The maintenance-free battery is unusually versatile in that it is designed either to be built into tools and appliances to to be carried by shoulder strap or belt hooks, as space and weight might dictate. It operates in any position—upright, upside down, on the side or tilted—with no risk of damage. Beside portable use, maintenance-free batteries are used as power sources for automatic emergency lighting units.

This type of battery never requires additions of water or acid, hydrometer readings or cleaning or metallic cell connectors (they are sealed into the cover of the container). Most other types of storage batteries must be serviced regularly to keep them operable.

Designed to be used as a complete power-package system, the maintenance-free battery is coupled with an automatic solid-state-type charging device that enables the battery to achieve its high-performance potential. The special charger operates on 115-volt alternating current and charges the battery in an upright position.

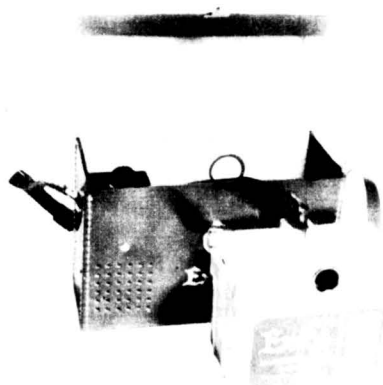


Figure 13. Maintenance-free battery and associated charger pack. Used to power portable TV sets.

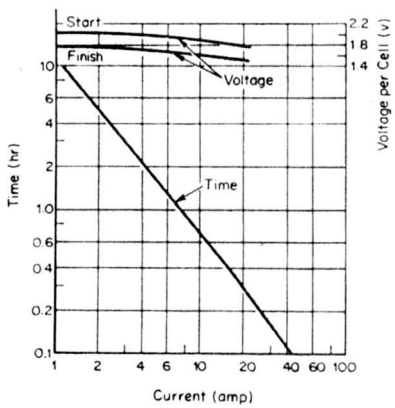


Figure 14. Voltage/current characteristics of 10AH maintenance-free battery at beginning and end of discharge cycle.

Such batteries are available in a 6-volt size with capacities of 6 and 10AH, and in the 12-volt size with capacities of 5 and 10AH. Typical performance of such batteries is shown in figure 14.

LEAD-CALCIUM BATTERIES: A comparatively recent development in lead-acid types is the lead-calcium version. In this the lead-antimony alloy commonly used for plate grids is replaced by a lead-calcium alloy. A development of the Bell Telephone Laboratories, it is suitable only for stationary standby service because heavy cycling causes the positive plates to expand or "grow."

However, use of lead-calcium batteries has definite advantages in specialised service. They have a low rate of hydrogen evolution. They require extremely low float-charge currents. They require a minimum of water. Thus, properly used, lead-calcium batteries

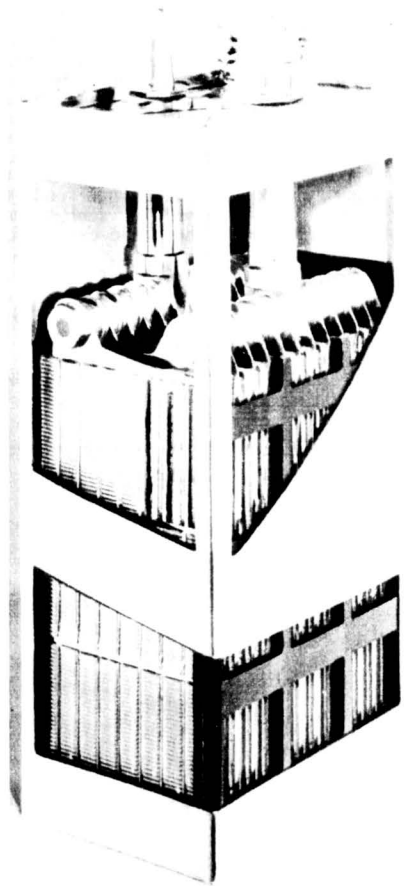


Figure 16. Photograph of cutaway nickel-iron cell, showing construction. See also figure 15.

*Assistant Technical Director, ESB Incorporated, U.S.A. (Formerly: The Electric Storage Battery Company).

have much longer lives than other flat-plate types of batteries. Beside wide usage in the telephone industry, lead-calcium batteries now are used on United States nuclear submarines to supply emergency power in case the reactors fail.

NICKEL-IRON BATTERIES: The nickel-iron cell bears a broad physical similarity to the lead-acid cell, but is quite different chemically. The positive plate is a nickeled-steel grid containing perforated nickeled-steel tubes into which the active material is inserted. The positive active material begins as nickel hydrate, but is changed by formation into a nickel oxide. The negative plate is a nickeled-steel grid containing perforated pockets of finely divided iron oxide. Figure 15 shows positive and negative plates of a nickel-iron cell.

The positive and negative groups are separately assembled by passing a connecting rod through holes at the tops of the grids. Steel washers provide the proper spacing with one of the spacers being the base of the pole. A nut is tightened at each end of the connecting rod.

The two groups are assembled into an element by intermeshing the plates (figure 16). The negative group contains one more plate than the positive group, so both outside plates are negative. The element is insulated from the container, and the plates are insulated from one another by vertical hard-rubber pins that extend the entire length of the plates. The container is constructed of nickel-steel and has all seams welded.

The electrolyte is a solution of dilute potassium hydroxide plus a small quantity of lithium hydroxide which increases the capacity and life of the cell. The electrolyte is a natural preservative of steel. Results of charging and discharging are mainly a transfer of oxygen ions back and forth between positive and negative electrodes of the cells. The reactions are completely reversible. Thus, with continued use of the battery, there is no loss of active material. Also, because the electrolyte is a steel preservative, there is no grid deterioration. The specific gravity of the electrolyte does not change during charge or discharge. The battery will not freeze at any state of charge.

When compared with lead-acid batteries, nickel-iron batteries have both advantages and disadvantages. The advantages are:

- Greater mechanical strength because major components are steel.
- No sudden loss of power because the active materials are contained securely inside the plates and cannot be lost. Thus, there is no deposit in the bottom of the cell to short-circuit the plates. Also, there is no corrosive reaction caused by the electrolyte.
- Indefinite storage. When the battery is to be stored, it is discharged, the terminals are short-circuited, and it is put in a clean, dry place. To return it to service, the battery merely is recharged.
- Wide range of operating temperature. Steel construction assures efficient dissipation of internal heat. Air space between cells permits heat to escape. The battery is safe from damage at temperatures far below

MORE ON SEALED LEAD-ACID BATTERIES

The following comment on sealed lead-acid cells is taken from the journal of the Australian Lead Development Association, "Lead-acid Battery Power," September, 1966.

"The small lead-acid battery is rapidly gaining recognition as the most suitable power source for many of these (portable appliance) applications. Until the appearance of truly portable sealed lead-acid batteries just a few years ago the nickel cadmium battery virtually had the portable appliance market to itself. By comparison however, the modern sealed lead-acid battery has a number of advantages for such use. It has a higher cell voltage. In initial cost it is only one-third or a quarter that of the nickel cadmium battery. Its service life is correspondingly shorter, but in cost per discharge cycle the two types are comparable, and for many domestic and industrial uses the lead-acid battery's life is more than adequate. Its low initial cost permits lower priced appliances while battery replacement where necessary entails relatively small expense.

"When assessed on a combination of all the usual requirements for a suitable rechargeable portable power source, namely initial cost, output and weight with reliable maintenance-free service, the portable lead-acid battery is without equal.

"Typical appliances which illustrate the capabilities of the sealed lead-acid battery are cordless electric drills with all the power of main-operated models and cordless TV sets now up to 12-inch screens.

"Development of small portable lead-acid batteries involved much more than simply building a smaller battery. Characteristics of the conventional vented battery such as gas evolution, the possibility of electrolyte spillage and the need for topping up cells are obvious disadvantages for use in portable equipment. Batteries must be sealed.

"Another essential requirement is that the new batteries should be not merely maintenance-free but entirely foolproof. In many applications batteries are used only seasonally and often left unused for several months. Inevitably they are also stored at times in a discharged condition. In conventional applications of lead-acid batteries these service conditions rarely arise. When they do excessive sulphation of the negative plates is caused by a natural "self-discharge" characteristic. This sulphation causes a permanent loss of capacity which impairs performance and shortens battery life.

"The problem of sulphation in portable batteries has been overcome by modification of battery grid alloys and the use of gelled electrolytes; the new types will recover their full capacity with a thorough charging even after several months standing idle."

Editorial Note: It should be emphasised that the main advantage claimed for the sealed lead-acid cell—an acceptable life on the basis of a low first cost—has not been evident in Australia. Such units as are available cost at least one an a half times as much as sealed nickel-cadmium batteries; a long way from the " . .one third or one quarter. . ." suggested in the above article. Similarly, acceptable shelf life has yet to be proved in this country, experience to date suggesting that a maximum of six months is about all that can be expected.

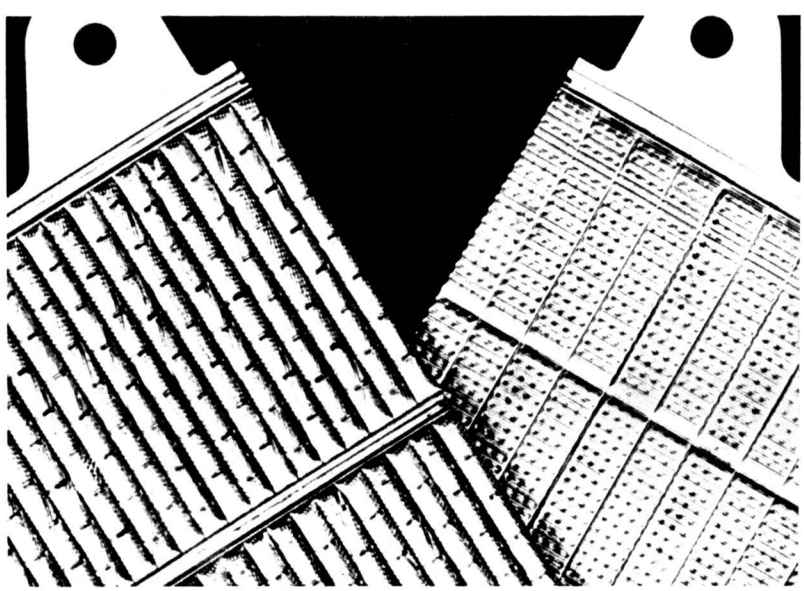


Figure 15. Detail photograph of the positive (left) and negative plates of the nickel-iron cell.

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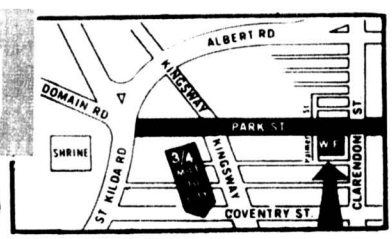

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freezing because the specific gravity of the electrolyte remains constant, regardless of condition of charge.

Disadvantages of nickel-iron batteries as compared with lead-acid are:

- Voltage output per cell is only 1.2 volts. Therefore, a nickel-iron battery of the same voltage as a lead-acid needs more cells.
- Voltage during high-rate discharge is lower.
- Performance at low temperature is less efficient.
- It consumes more water.
- It generates more heat.
- Charge retention is not as good.
- Initial cost is greater.

Rated capacities range from 5 to 900AH for a standard 5-hour discharge rate. Typical voltage-discharge characteristics are shown in figure 17. Because of their advantages, many nickel-iron batteries are used in motive power service. They also are used widely in lighting and signalling systems and in railcar service.

NICKEL - CADMIUM BATTERIES: Construction of the nickel-cadmium battery (figure 18) is similar to that of the nickel-iron battery except that:

- The positive plates are the pocket type rather than tubular.
- Positive active material is nickel hydrate and graphite.
- Negative active material is cadmium and iron.
- Containers can be plastic as well as steel.

During the discharge, the nickel hydrate of the positive plate is reduced, and the hydroxyl ion combines with the cadmium of the negative plate to form cadmium hydrate. Because this reaction is reversible, the hydroxyl ion combines with the nickel during recharging. There is no change in the electrolyte, dilute potassium hydroxide (KOH), which acts only as an ion carrier as in the nickel-iron battery. Discharge characteristics of nickel-cadmium batteries at various temperatures are shown in figure 19.

The three main types of cadmium-pocket batteries are (1) normal rate, (2) high rate and (3) very high rate.

Normal Rate: This type of cell has normal internal resistance and is suitable for small and fairly constant loads. Emergency and portable lights, alarm circuits, instrumentation, railway signalling, marine lighting and communications are typical applications for normal-rate batteries.

High Rate: Cells of this type have low internal resistance and are suitable for applications where loads vary widely and require large currents without substantial voltage drop. High-rate batteries are used to operate switchgear, to start small engines and to supply power for marine radio and telephone exchanges.

Typical capacities range from 10 to 360AH at the 8-hour rate of discharge, to 1.14 volts per cell.

Very High Rate and Special: Such cells have extra-low internal resistance. They are suitable where very high currents, relative to capacity, are required and where minimum voltage drop is imperative.

Typical applications are for starting

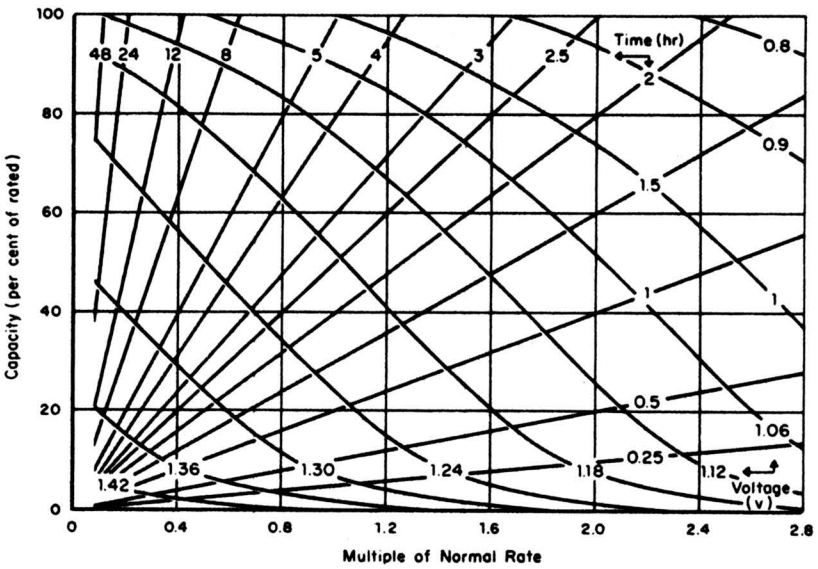


Figure 17. Voltage discharge characteristics of typical nickel-iron cells, at the 5-hour rate, to 1V.

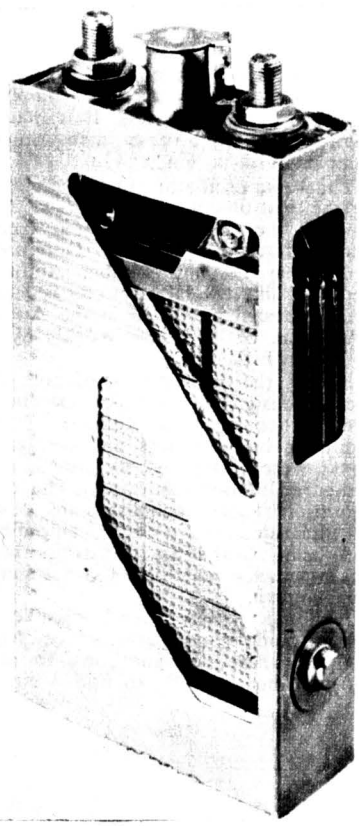


Figure 18. Photograph of cutaway nickel-cadmium cell.

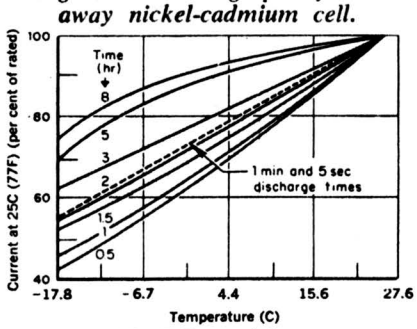


Figure 19. Effect of low temperature on discharge characteristics of nickel-cadmium cell.

gas turbines and large diesel engines. Capacities range up to 280AH at the 8-hour rate.

Because nickel-cadmium batteries are quite similar to nickel-iron, most of the same advantages over lead-acid batteries apply.

In addition, a nickel-cadmium battery has excellent charge retention.

A layer of oil on the electrolyte surface reduces water evaporation, thus extending intervals between waterings.

Besides having the disadvantage of being a relatively expensive power source, the nickel-cadmium battery should not be operated at high rates of charge or discharged with an electrolyte temperature exceeding 46 deg. C. (115 deg. F.). ■

A new Solid-State AF Signal Generator

An up-to-date laboratory instrument design employing silicon transistors and a microcircuit, capable of delivering either sine or square waves over a wide frequency range at low distortion up to 10V RMS amplitude.

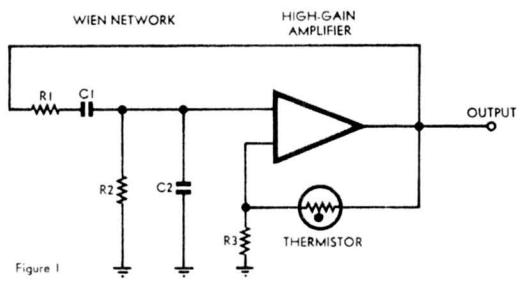


Figure 1

by Jamieson Rowe

The AF signal generator to be described has been designed as a modern solid-state counterpart of our previous valve designs, the last of which was described in the February, 1962, issue of the magazine (then "Radio, Television and Hobbies"). It offers the full functional and performance features expected of a laboratory signal generator, yet may be constructed at an outlay considerably less than the cost of comparable commercial instruments.

The frequency range covered is from 3Hz to 300KHz, the instrument having five switched decade bands which are continuously tunable. Alternative output waveforms are available over the full frequency range, either low-distortion sine waves or square waves. Total harmonic distortion, hum and noise components at maximum output (10V RMS) for sine wave output is less than .06 per cent between 100Hz and 10KHz (see specification panel); while the squarewave rise and fall times are less than 100nS, with overshoot, and droop at 5Hz both less than 10 per cent. At frequencies above 10Hz the droop on squarewave is negligible.

The output level is maintained flat within 0.5dB over the full frequency range, and is monitored by a 3-inch rectangular panel meter. Both coarse and fine output attenuators are provided, the former giving a total of eight 10dB steps, while the latter provides more than 20dB of additional stepless attentuation. By means of the output meter the output level may be set conveniently and accurately to any level between 10V RMS and a few hundred microvolts, at a source resistance of less than 600 ohms on all settings.

The instrument operates from 240V AC, and has a power consumption of approximately 6 watts. It is housed comfortably in a case measuring a compact 12in x 6in x 4¼in.

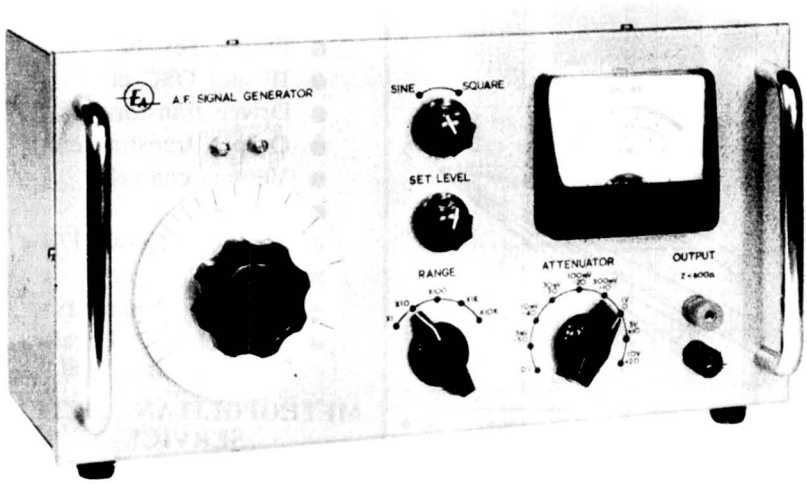
The basic oscillator circuit employed in the instrument is similar to that used in the "Transistor Audio Generator" described in the December, 1967 issue by staff member Anthony Leo, and like the latter circuit is based upon a design published in the August 1967 issue of "Wireless World" by P. F. Ridler, B.E.

During the development of both the present design and that of December 1967, a considerable number of AF oscillator basic circuits and configurations were critically examined and compared in our laboratory. The configurations tested included many based on integrated micro-circuit amplifiers, and using field-effect transistors both for impedance matching and automatic level control.

Although it was found possible to obtain quite good performance from some of these configurations, to date we have been unable to find a circuit or configuration which is capable of performing as well as a discrete-components circuit using bipolar silicon transistors and based upon the design by Ridler. Hence the latter approach would appear to be capable of providing close to the best performance available at the current state-of-the-art from circuitry of moderate complexity, and it is for this reason that we have adopted it for both the recent and present projects.

The oscillator circuit is of the "Wien bridge" type, and for those unfamiliar with this configuration it is shown in basic form in figure 1. As may be seen it consists of a high-gain differential amplifier fitted with two separate feedback circuits. One circuit, consisting of resistors R1 and R2 and capacitors C1 and C2, connects from the amplifier output back to the "+" input and therefore provides **positive feedback;** the other circuit consists of resistor R3 and the thermistor (negative temperature-coefficient resistor), and is connected between the output and the "—" input to provide **negative feedback.**

The configuration in which R1, R2, C1 and C2 are connected is known as the "Wien network," and is capable of performing in a manner roughly corresponding to an L-C tuned circuit. At a particular frequency determined by the values of the four elements



The prototype generator complete in its case. As may be seen, its appearance is in keeping with the performance attained.

Specification

An AF signal generator which delivers high-quality sine or square wave signals tunable continuously over the range 3Hz — 300KHz in five switched bands. The instrument is fully solid-state and employs nine silicon transistors, five diodes and an integrated RTL microcircuit.

Maximum output level is greater than 10V RMS, with an output impedance of less than 600 ohms. Both coarse and fine attenuators are provided for adjustment of output level, the former providing a total of 70dB attenuation in 10dB steps while the latter control provides more than 20dB of additional stepless attenuation. The output level applied to the final (coarse) attenuator is monitored by an output level meter which is calibrated in volts, millivolts and decibels.

Output level is flat within 0.5dB over the full frequency range. Total harmonic distortion, hum and noise at 10V RMS sinewave output is less than .06p.c. between 100Hz and 10KHz, rising to 0.1% at 50 Hz and 30KHz and to approximately 0.25% at 10Hz and 300KHz. Squarewave rise and fall times are less than 100nS; overshoot and droop at 5Hz both less than 10%. Above 10Hz droop negligible.

Output level meter response is flat within 0.5dB from 3Hz — 300KHz.

The instrument operates from 240V AC, having a power consumption of approximately 6 watts.

The complete circuit of the new generator, which employs nine silicon transistors and an integrated microcircuit.

(and possibly modified by source and output loading impedances), the transmission loss of the network falls to a minimum while the phase shift also passes through zero.

This "pseudo-resonance" occurs at frequency Fo, where Fo may be found from the following equation providing the driving source impedance is negligibly low compared with the series elements (R1, C1) and the output loading impedance is negligibly high compared with the shunt elements (R2, C2):

$$Fo = \frac{1}{2\pi\sqrt{R1.R2.C1.C2}} \quad \ldots (1)$$

It may be noted that the right-hand side of this equation bears a formal resemblance to the expression for the resonant frequency of an L-C tuned circuit.

If R1 and R2 are made equal in value, and C1 and C2 similarly given equal values, equation (1) reduces to

$$Fo = \frac{1}{2\pi RC} \quad \ldots (2)$$

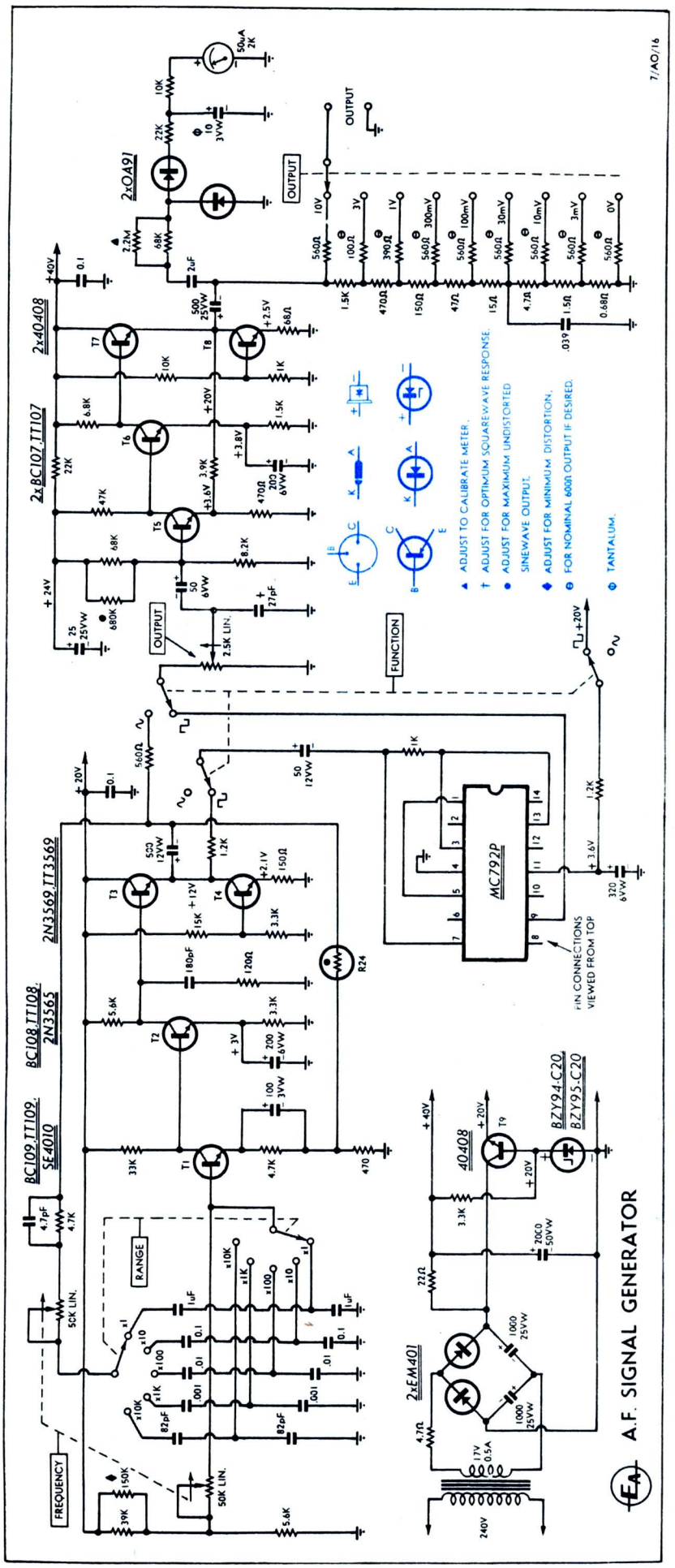
In this case the transmission loss falls at Fo to a minimum of 3.0—or in other words there is a maximum transmission "gain" of 0.33. The phase shift is zero as before.

For an active system such as a feedback amplifier to produce sustained oscillations at a particular frequency, it may be recalled, the overall gain around the feedback loop must be at least unity and the phase shift either zero or a multiple of 360 degrees. In simple terms this means that the amplification must have a gain at least equal to the loss of the feedback network, and have a phase shift such that the output produced in response to a feedback signal is synchronous with the output signal from which the feedback signal was derived.

Hence for the circuit of figure 1 to produce sustained oscillations at the "pseudo-resonant" frequency, the gain of the amplifier must be at least 3 times, to compensate for the loss in the Wien network. And the phase shift must be either zero or a multiple of 360 degrees, as the phase shift of the Wien network at Fo is zero.

While the criterion for sustained oscillation of such a system is simply that the overall loop gain be at least unity for zero phase shift, a loop gain of higher than unity is undesirable because this corresponds to oscillations which **grow** in amplitude. What in fact happens with a loop gain exceeding unity is that the oscillation amplitude grows until saturation, cutoff or other non-linear limiting effects within the amplifier act to reduce the instantaneous loop gain on signal peaks. An equilibrium is then reached, with the oscillation amplitude remaining constant—but with significant distortion of the waveform on one or both peaks.

In order to produce sustained oscil-



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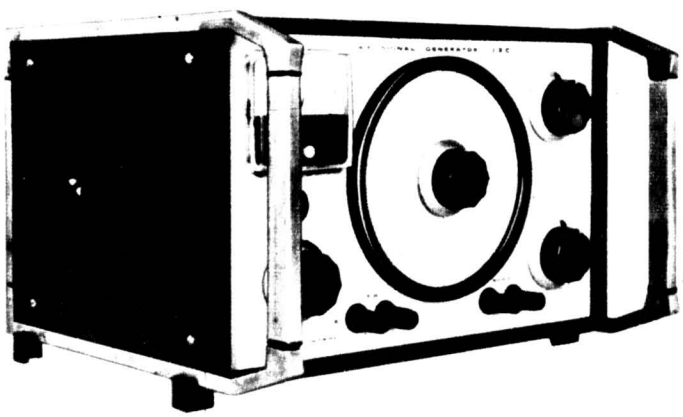

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Dimensions:	11⅛" x 7⅝" x 9⅝".
Weight:	20 lb.
Power:	105 to 125V and 210 to 250V—40 to 100 Hz—40 Watts.

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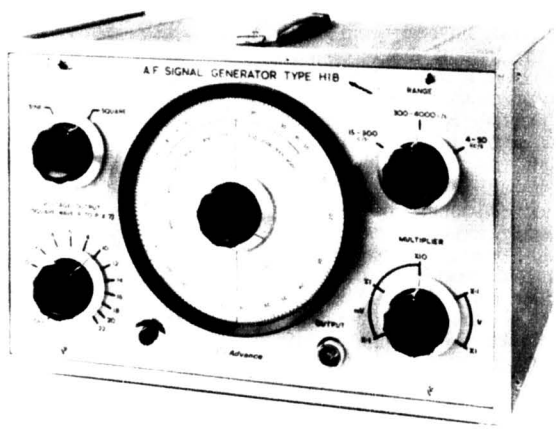
The Advance Model H1B has provision for square-wave output to assist in the quick testing of low-frequency amplifier response, recovery and phase distortion. Testing or alignment of most networks may be carried out quickly.

Frequency:	15 Hz to 50 kHz.
Accuracy:	Sine wave ± 1% to 1 Hz. Square wave ± 3% to 1 Hz.
Rise Time:	Less than 3 μ s. (10% to 90% of peak).
Output:	Sine wave: 200 μ V to 20V r.m.s. ± 2dB. Impedance: Maximum 13 kΩ. Square wave: 1.4 mV to 140V P-P (approx.).
Distortion:	Less than 1% at 1 kHz at a level of 20V—± 2dB.
Dimensions:	7⅝" x 11⅛" x 9⅝".
Weight:	12¾ lb.
Power:	105 to 125V and 210 to 250V—40 to 100 Hz—30 W (approx.).

Price: $100 plus Sales Tax as applicable.



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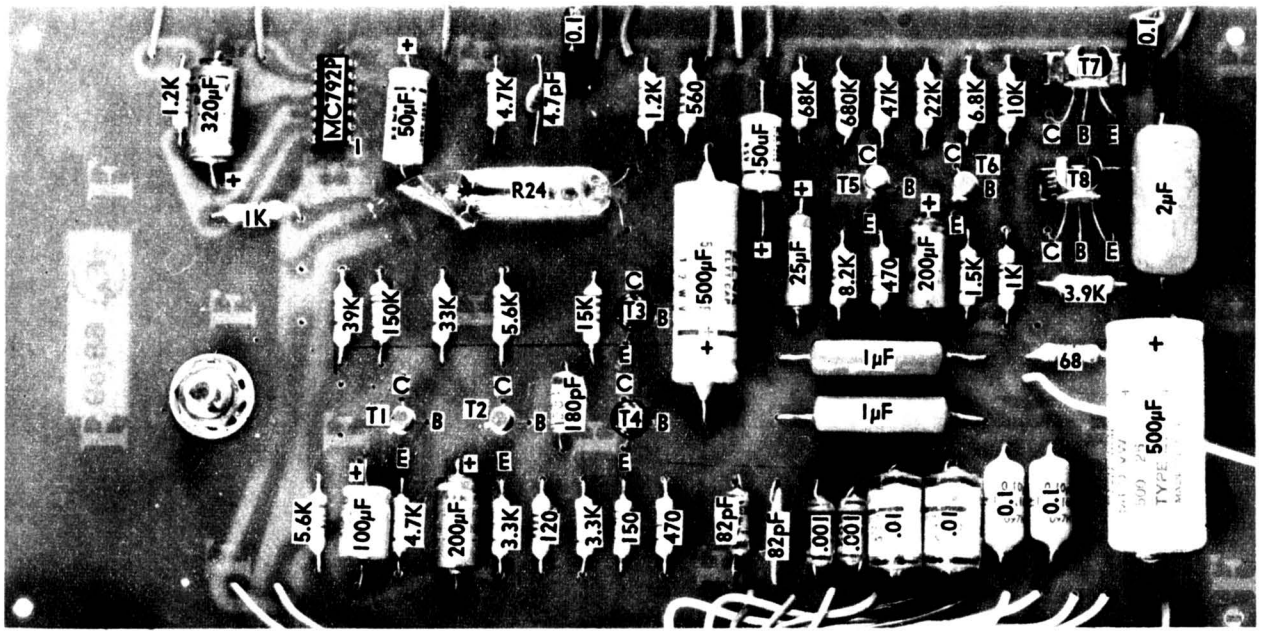

Using this coded photograph, constructors should find no difficulty in placing components on the printed wiring board.

lations at a constant amplitude and with low distortion, therefore, it is necessary to maintain the overall loop gain accurately at unity. There are a variety of methods whereby this may be achieved, but probably the most straightforward method and one which generally gives quite good results is that shown in figure 1. As may be seen it involves a negative feedback circuit consisting of resistor R3 and a thermistor.

In theory, providing the amplifier has an open-loop gain of greater than the required 3 times, simple "linear" negative feedback could be used to adjust its gain accurately to that figure. However, the feedback would have to be critically adjusted, both initially and thereafter on an almost continuous basis, to compensate for amplifier gain and Wien network drifts.

By using a thermistor in the feedback circuit, in the position shown, the circuit is made to perform its own continuous and automatic gain adjustment. This occurs in the following manner:

The thermistor has a negative temperature coefficient of resistance — in other words, its resistance falls as its temperature rises. Hence when the circuit of figure 1 is first switched on the thermistor will have a high resistance, there will be little negative feedback, and the high gain around the positive feedback loop will speedily initiate oscillations of rising amplitude.

As the oscillations grow, the temperature of the thermistor will rise also, as the latter and resistor R3 are effectively connected in series across the amplifier output and will accordingly draw signal current. Hence the resistance of the thermistor will fall, the negative feedback will increase and the effective amplifier gain will drop.

It should be apparent that an equilibrium will be reached, as the output amplitude can only rise to the point where the thermistor has increased the negative feedback on the amplifier to correspond to an effective gain of 3 times—giving unity loop gain. If the oscillation amplitude tends to rise above this level, the thermistor will reduce the loop gain slightly below unity and the oscillations will begin to die away; conversely if the amplitude tends to fall, the thermistor will increase the loop gain slightly above the unity to correct it.

In short, the "non-linear" negative feedback action produced by the thermistor acts to continuously and automatically maintain the loop gain accurately at unity, and the oscillation amplitude constant. By employing a thermistor with a suitable temperature/resistance characteristic, the output amplitude may be maintained at a level well below amplifier limiting, and the output waveform may thus be arranged to have low distortion.

The actual degree of distortion present in the output will naturally depend largely upon the linearity of the amplifier itself, as one might expect. In order to produce an oscillator with very low distortion, it is therefore necessary to base the design in the first instance upon an amplifier having low inherent distortion at signal levels below limiting.

The amplifier configuration employed in the present design may be seen by reference to the main circuit diagram. It comprises four silicon NPN transistors T1, T2, T3 and T4, together with associated components.

The first stage employs T1 in a conventional common - emitter configuration, with the base connected directly into the Wien network and the negative control feedback signal applied to the emitter via the unbypassed 470 ohm resistor (equivalent to R3 in figure 1). The base bias divider for T1 forms part of the resistive shunt Wien element (R2), the remainder being formed by a 50K wire-wound potentiometer. The latter is ganged to a similar pot in the series arm, the two forming the "fine tuning" control of the instrument. A fixed 4.7K resistor in series with the second pot forms the remainder of the series resistive element (R1), balancing the equivalent resistance of the base bias divider.

The capacitive Wien elements (C1 and C2) are switched to provide the five decade tuning ranges. It will be noted that the values of the pairs of capacitors are related by a factor of 10 for all but the highest frequency range, where the values are lower than might be expected. The reason for this is that stray wiring capacitance in fact provides the remaining capacitance for this range.

Further stray capacitance across the bias divider also tends to restrict the extent of the highest range. This is compensated by the 4.7pF capacitor across the 4.7K series element, which thus ensures that the highest band maintains the correct decade ratio.

Transistor T2 forms the second stage of the amplifier, and is again a conventional common-emitter stage which is direct coupled to the collector of T1. A series R-C step circuit connected from the collector of T2 to earth is used to modify the loop gain/phase characteristic of the amplifier at high frequencies, ensuring that the oscillator remains free from parasitic oscillations on the highest range.

Transistor T3 is used as an output emitter-follower stage for the amplifier, contributing a slight voltage loss but appreciable current gain. This gives the amplifier a low output impedance and thus ensures correct operation of the feedback circuits.

In place of the usual resistive load for T3, a fourth transistor T4 is used, biased to draw a collector current equal to the optimum emitter current of T3. As a result of the high effective AC collector-emitter resistance of a bipolar silicon transistor when biased in the "pentode" or "constant current" region, T4 thus provides T3 with a load which represents at one and the same time a low DC resistance combined with a high AC resistance.

Because of this, the peak-to-peak emitter current excursions of T3 for a given output signal amplitude are a minimum. Accordingly, the current gain of T3 varies far less than is usually the case during the signal

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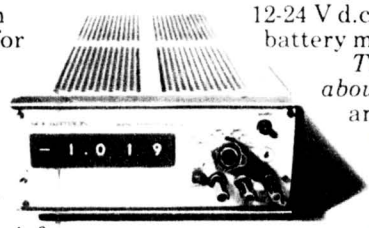

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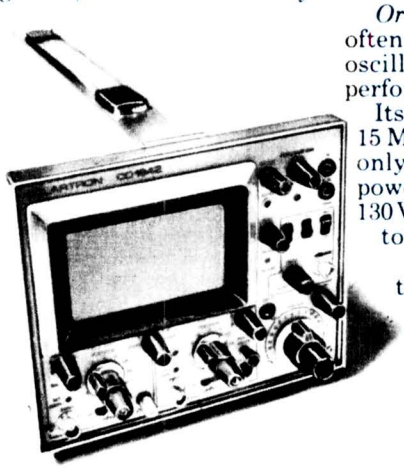

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cycle, and harmonic distortion is reduced considerably.

The actual distortion level produced by the oscillator depends in a rather complex fashion upon the DC operating conditions in the various stages of the amplifier. However, in most cases there will be a rather well-defined minimum in output distortion, at a particular overall operating point. Hence in order to set the circuit for minimum distortion, the most convenient method is to adjust the bias on T1 by varying the high-value shunt across the upper bias divider resistor (identified on the circuit with a diamond symbol).

The minimum distortion point will generally correspond approximately to the "half supply voltage" condition at the emitter of T3; i.e. the emitter voltage of T3 will tend to be somewhere near +10V. However, some idea of the possible deviation from this situation may be gained from the fact that the prototype unit shown produces minimum distortion with the emitter of T3 at +12V.

The thermistor used in this circuit is an STC type R24, whose resistance/temperature characteristic is such that the oscillator output level will fall between about 1.2 and 1.5V RMS. At this level the dynamic control response of the R24 thermistor provides quite good oscillator amplitude stability, both with respect to disturbance recovery and also to ambient temperature variations.

In order to provide the instrument with alternative squarewave output, switching is provided which, when required, directs the output from the oscillator through a squaring circuit. The latter employs an integrated digital microcircuit—a Motorola device, type MC792P, which is a triple three-input gate based on RTL circuitry. Two of the MC792P gates are wired in a Schmitt-trigger type configuration, which provides initial squaring of the oscillator sinewave, while the third gate provides follow-up squaring and buffering.

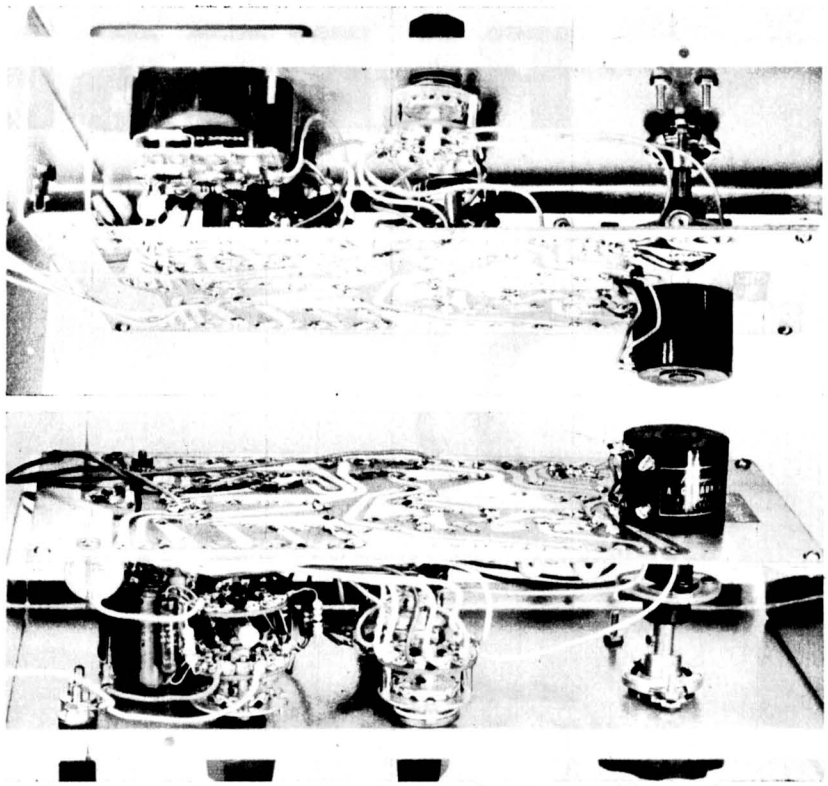
In passing it should perhaps be noted that Motorola Semiconductor products may be ordered from Cannon (Aust.) Pty. Ltd., of 58 Cluden Street, Street, East Brighton, Vic. 3187, also at P.O. Box 25, Mascot, N.S.W., 2020, and Commonwealth Aerodrome, Parafield, S.A., 5106.

The output amplitude from the squaring circuit is approximately 3.2V P-P, which is close to that of the oscillator itself.

In order to fully qualify as a laboratory-grade instrument, it is necessary that an AF signal generator be capable of delivering an output level of at least 10V RMS, at a source impedance of no higher than approximately 600 ohms. Accordingly the present instrument is provided with an output buffer amplifier designed to satisfy these criteria.

The amplifier is a three-stage feedback circuit based on the same configuration used in the oscillator section, and again using four silicon NPN transistors T5, T6, T7 and T8. Heavy negative voltage feedback is applied, operating both for DC and AC, and this provides a high order of gain and operating point stability. The effective signal voltage gain of the amplifier is approximately 9.3 times, and within approximately 0.2dB of this figure over the frequency range of the oscillator—a performance which is adequate to provide the instrument with an output of more than 10V RMS on both sine and square-wave signals.

The output stages of the amplifier are



Two views of the front panel wiring-board assembly of the new generator, presented to assist readers wishing to duplicate the prototype construction.

List of Components

1 Case 12in x 6in x 4½in, with wiring board and power supply brackets.
1 Rotary dial plate (see text).
1 Printed wiring board 68/o9.
1 50uA 2K meter, 3in rectangular.
1 Power transformer, 240V to 17V at 500mA nominal.
1 3-pole 3-position rotary switch.
1 2-pole 5-position rotary switch.
1 Single-pole 9-position rotary switch, with dummy wafer.
5 Control knobs.
2 Output terminals.
2 Chrome handles.
1 Type R24 thermistor.
1Planetary reduction drive, ¼in to ½in.
1 Flexible shaft coupling, ¼in to ½in.

SEMICONDUCTORS

2 Silicon rectifiers type EM401, IN5059, OA605 or similar.
2 Germanium diodes type OA91 or similar.
1 Nominal 20V zener, type BZY94-C20 or similar.
1 BC109, TT109 or SE4010.
2 BC107,TT107 or similar.
1 BC108, TT108, or similar.
2 2N3569, TT3569 or similar.
3 40408 or similar.
1 MC792P integrated microcircuit (see text).

RESISTORS

1 2.5K linear pot.
1 50K-50K ganged wire-wound pot, high quality type.
Half-watt 5 per cent type: 4.7ohms, 22 ohms, 68 ohms, 120, 150, 2 x 470, 2 x 560, 2 x 1K, 2 x 1.2K, 1.5K, 3 x 3.3K, 3.9K, 2 x 4.7K, 2 x 5.6K, 6.8K, 8.2K, 2 x 10K, 15K, 2 x 22K, 33K, 39K, 47K, 2 x 68K, 150K, 680K, 2.2M.
High stability, preferably 1 per cent type: 0.68 ohms, 1.5 ohms, 4.7 ohms, 15 ohms, 47 ohms, 150, 470, 1.5K.

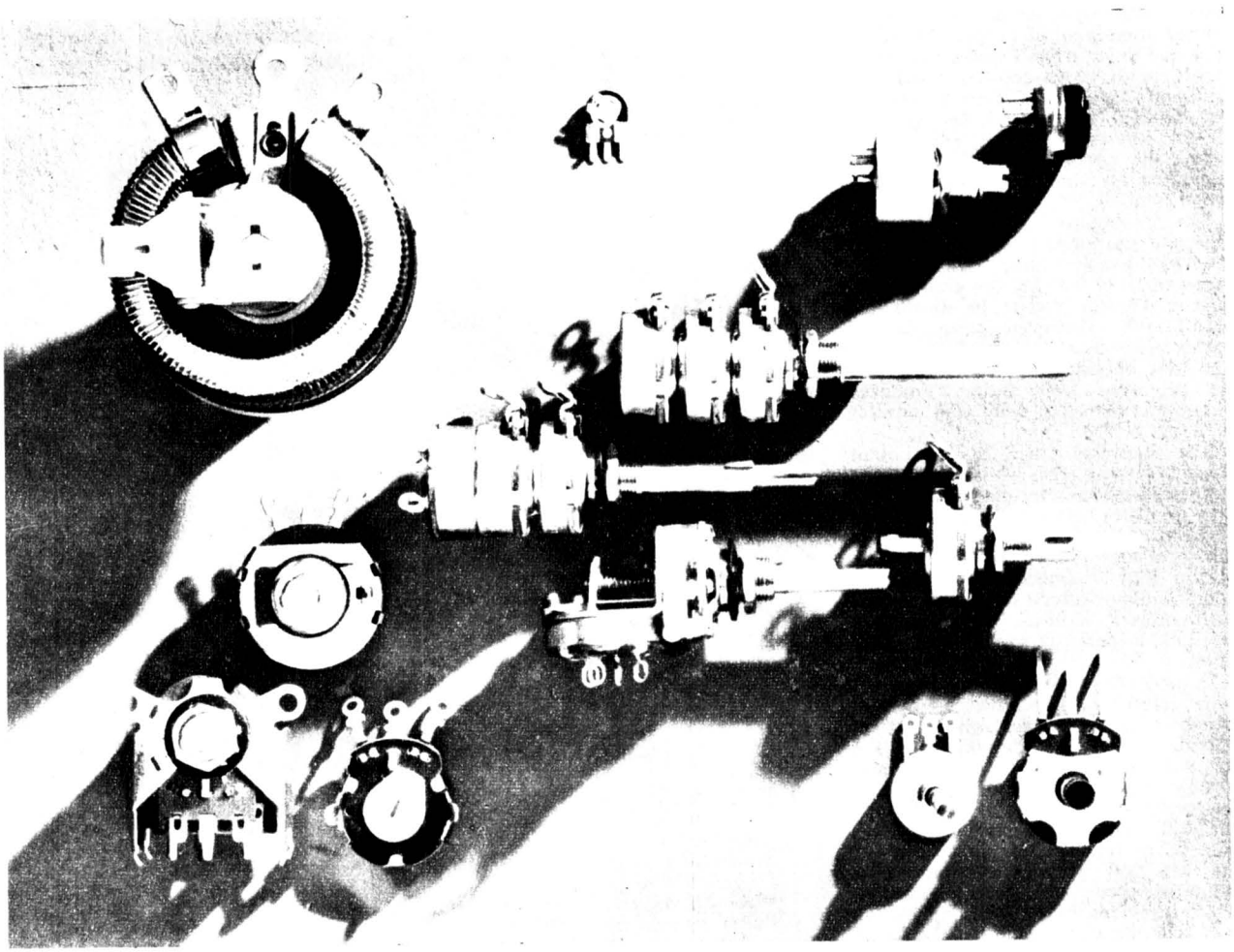
CAPACITORS

Low voltage, polyester or polystyrene: 4.7pF, 27pF, 180pF, .039uF, 2 x 0.1uF, 2uF.
High stability, close tolerance: 2 x 82pF, 2 x .001uF, 2 x .01uF, 2 x 1.0uF.
Electrolytics: 10uF 3VW (tantalum), 25uF, 25VW, 50uF, 6VW, 50uF 12VW, 100uF, 3VW, 2 x 200uF 6VW, 320uF 6VW, 500uF 12VW, 500uF 25VW, 2 x 1,000uF 25VW, 2,000uF 50VW.

MISCELLANEOUS

Mains cord and plugs; grommets; spring clips for 40408 transistors; 8-lug length of minature resistor panel; 2 x 8-lug tagstrips; 1 x 5-lug tagstrip; 1 x 2-lug tagstrips; scrap acrylic sheet for dial cursor; connecting wire, solder, nuts, screws, washers, etc.

PLESSEY



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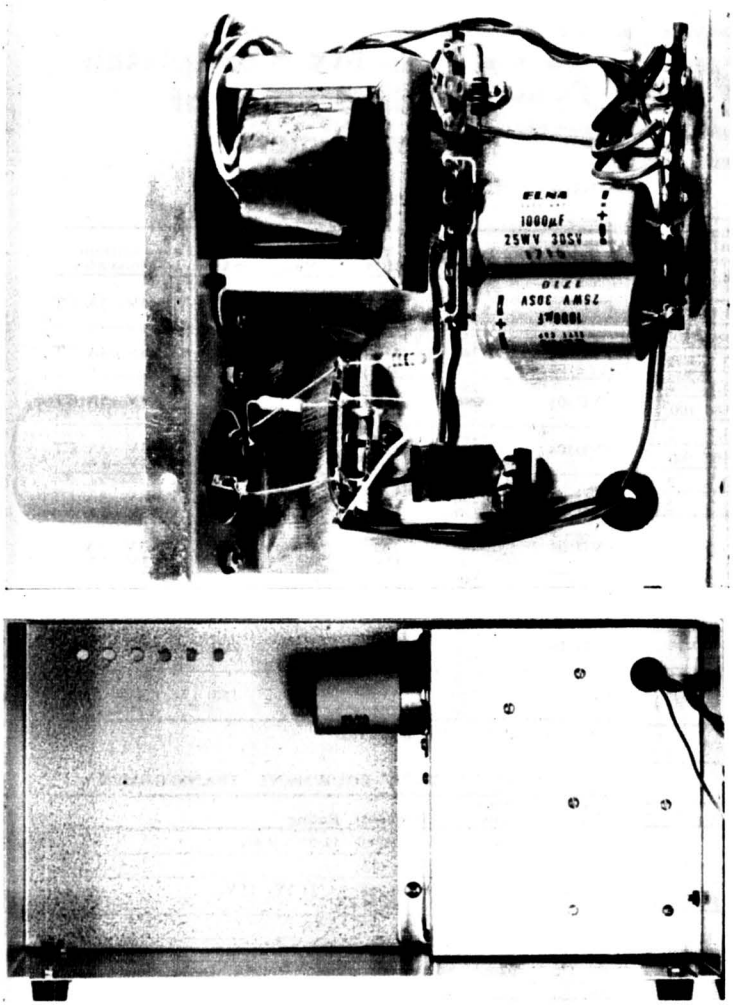

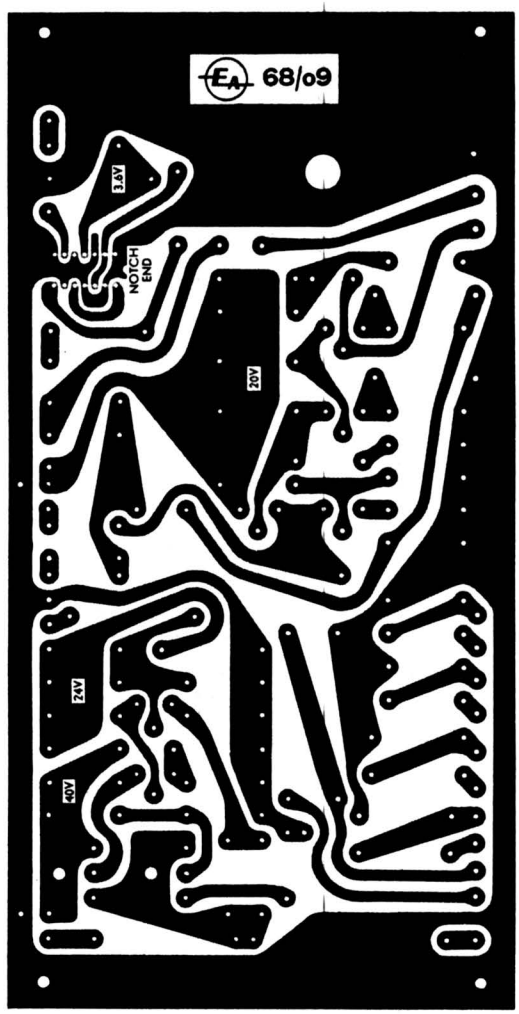

At upper left is a view inside the power supply bracket, while beneath is a view of the bracket mounted inside the case. At right is a reduced copy of the printed wiring board pattern.

operated from a +40V supply rail, in order to provide the required peak-to-peak output voltage capability. As a result of the high supply voltage, the use of heavy negative feedback, and the use of transistor load T8 for the output transistor 27, the amplifier is typically capable of delivering more than 10.5V RMS output over the full frequency range of the oscillator, with hum, noise and distortion at an almost unmeasureable level (typically around —90dB relative to full output).

In order that the instrument should provide an output impedance of less than 600 ohms, the amplifier output stage must be capable of developing 10V RMS across a minimum load of this value, with negligible distortion. Hence as the output stage is basically an emitter-follower operating in class A, it must be operated at a quiescent current at least equal to, and ideally somewhat greater than, the peak signal current required in the latter condition. This is equal to (1.414 times 10)/600, or 23.6mA.

To allow a comfortable margin for component tolerance variations and similar factors, the output stage quiescent current in the present design has been set at approximately 37mA. This figure should ensure that the instrument will be capable of delivering rated output at all times.

Naturally enough this quiescent current level, combined with the moderately high supply voltage used for the output stage, results in appreciable power dissipation in the output transistor T7 and its load T8. Each in fact is required to dissipate some 740mW, dictating the use in these positions of a device having both higher voltage and higher dissipation capabilities than the devices used in the foregoing stages.

As may be seen from the circuit the device which has been selected for T7 and T8 is the 40408, an RCA type employing a metal-header TO-5 encapsulation. For the present application, this device is quite conservatively rated, with a BVceo rating of 90V and a dissipation capability of some 860mW at 50 degrees C. ambient. However, to provide as large a "safety margin" as possible for the instrument, in keeping with its pretentions, it is recommended that the devices be fitted with small spring-clip radiators to lower the case-ambient thermal resistance.

The undistorted output capability of the buffer amplifier is naturally dependent upon the quiescent operating point, as with the oscillator amplifier. In this case, the optimum operating point corresponds closely to the situation where the emitter voltage of T7 is at half the supply voltage—i.e., 20V. As before, setting-up of the operating point is performed by means of a high-value shunt across the upper bias resistor of the input stage (T5).

"Fine" adjustment of output level is performed by a potentiometer at the input to the buffer amplifier. A small capacitor shunting the rotor of the potentiometer to earth is used to compensate for stray capacitance breakthrough at the highest frequencies (evident only as squarewave overshoot).

Coarse attenuation of output level is performed by a low-impedance divider chain at the buffer amplifier output. The resistor values used in the divider are multiples of 15 and 4.7, which are the preferred values giving attenuation steps closest to the required 10dB (within 1 per cent, excluding resistor tolerance). The total divider resistance is approximately 2.2K. A small capacitor is shunted across the three lowest ranges for stray capacitance compensation at the highest frequencies.

A 560 ohm resistor is fitted in series with the output on the zero attenuation (10V) range, to ensure that the buffer amplifier output stage cannot be disturbed or damaged by the application of very low resistances across the output of the instrument. Similar resistors are not required for the remaining ranges, but can be fitted where shown if it is desired that the instrument present a fairly constant output impedance of nominally 600 ohms.

Output level monitoring is performed by a passive half-wave voltage doubling rectifier and meter circuit connected to the output of the buffer am-

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OPM19A	5	7000, 5000	S.E. 500, 250, 166, 100
OPM 2A	7	10000	P.P. 15, 8 3.7, 2
OPM 7A	15	(10000) 8000, 7000	P.P. 15, 8 3.7, 2
OPM 8A	15	(10000) 8000, 7000	P.P. 500, 250, 166 100
OPM10A	25	(8000) 6600	P.P. 15, 8 3.7, 2
OPM 9A	25	(8000) 6600	P.P. 500, 250, 166 100
OPM14A	35	(8000) 6600	P.P. 15, 8 3.7, 2
OPM13A	55	3500	P.P. 15, 8 3.7, 2

Impedance in brackets indicate screen taps available.

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		Hi-Fi Using Oriented Grain Steel for Mullard 5-Stereo-7 Playmaster 2 & 4	
OP412	7	9000 + Screen Taps	PP. 15 7.5 3.7 2
		Hi-Fi for Mullard 5-10 Amplifier	
OP308/15	12	8000, 6000	P.P. 15 3.75*
		Ultra-Linear	
OP301/15	12	8000 + Screen Taps	P.P. 15 3.75*
OP312/15	25	6600 + Screen Taps	P.P. 15 3.75*
		For 6GW8's (ECL86's)	
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PF299	240	285/285	40	6.3V—2A 6.3V—tap5V—2A
PF201	240	225/225	50	6.3V—2A
PF151	230, 240	285/285	60	6.3V—2A C.T 6.3V—tap 5V—2A
PF1460	230, 240, 250	250/250	80	6.3V—2A C.T 6.3V—2A 6.3V—tap5V—2A
PF130	230, 240	285/285	100	6.3V—2A C.T 6.3V—2A 6.3V—tap5V—2A
PF174	230, 240	285/285	150	6.3V—3A 6.3V—3A C.T. 6.3V—tap5V—3A

POWER TRANSFORMER
General Purpose—Voltage Doubling

Type No.	Primary Volts	H. T. Volts (R.M.S.)	DC Output After Doubler Volts	DC Output After Doubler mA	Low Tension Secondaries
PVD100	250 240 230	120 110 100	310 285 260	80	6.3V—3A CT
PVD102*	250 240 230	120 110 100	310 285 260	100	6.3V—4A CT
PVD103	250 240 230	50 140 130	380 355 330	100	6.3V—5A CT
PVD104	250 240 230	120 110 100	310 285 260	125	6.3V—3A CT 6.3V—3A
PVD105	250 240 230	146 136 126	380 355 330	125	6.3V—3A CT 6.3V—3A
PVD108	250 240 230	173 163 153	450 425 400	150	6.3V—3A CT 6.3V—3A
PVD109	250 240 230	146 136 126	380 355 330	180	6.3V—3A CT 6.3V—4A
PVD110	250 240 230	193 183 173	500 475 450	200	6.3V—3A CT 6.3V—4A
PVD111*	250 240 230	124 114 104	310 285 260	150	6.3V—3A CT 6.3V—3A CT

*Also available in flat mounting;

LOW VOLTAGE EQUIPMENT TRANSFORMER

Type No.	Primary Volts	Secondary Rating
PF537	240	17V tapped 11.5V—0.4A
PF1848	240	17V—1.25A
PF265	240	17V tapped at 11.5V, 10V, 8.5V at 4.2A
PF2344	240	18V, 0, 18V, 2.5A
PF2114	24	20V, 0, 20V, —2A DC
PF2440	240	19.4V, 0, 19.4V, —1.5A DC
PF2228	240	30V—0.6A
PF1763	240	30V tapped at 25V, 20V—2A
PF2876	240	32V at 1A 32V at 1A
PF2004	240	35V, 0 35V, —750mA
PF114	240	50V—2.3A tapped at 24V—4.8A tapped 12V—9.6A
PF115	240	50V tapped at 30V, 25V, 15V—5A
PF2235	240	150V, 125V, 100V, 75V, 50V, 25V, or 75V 0 75V at 30mA 6.3—1.2A

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PF1290	240	6.3V—0.6A insulated for 2500V working
PF2315	240	6.3V—1.2A
PF1728	240	6.3V—1.1A, 6.3V—1.1A or 12.6V—1.1A C.T. if series connected or 6.3V—2.2A parallel windings.
PF1630	240	5.3V—2.25A C.T.
PF476	240	6.3V—3A C.T.
PF162	240	6.3V—3A, 6.3V—3A C.T. or 12.6A—3A C.T. if series connected.
PF2565	240	12.6V—0.5A 12.6V—0.5A or 25V—0.5A if series connected or 12.6V—1A parallel windings.
PF2851	240	12.6V C.T. at 0.15A.

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plifier. The meter used is a 3in rectangular 50uA type, that used on the prototype instrument being a Japanese unit type VP-2A imported by Electronic Supplies, of Box 417, P.O., Crown Street, Sydney, 2010. It is available from many trade suppliers.

As the metering circuit is a passive one, it must be connected as shown to the top of the coarse attenuator. This is quite standard practice. However, it should be noted that because of this the meter reading will strictly indicate only the open-circuit output level for any given combination of coarse and fine attenuator settings.

This must be borne in mind particularly when the output of the instrument is connected into low impedance circuitry. In such cases, the meter reading will indicate not the actual output, but rather the signal level being applied to a voltage divider formed by the load impedance, together with the effective output resistance of the instrument on the coarse attenuator range concerned.

The power supply of the instrument consists of a "full-wave" voltage doubler rectifier, employing a power transformer having a nominal secondary rating of 17V at 0.5A. A single section of R-C filtering is used following the rectifier for the +40V supply line, while a simple zener-reference series regulator circuit is used for the +20V oscillator supply line. The series regulator transistor is again an RCA type 40408 device, fitted with a small metal clip radiator as with T7 and T8.

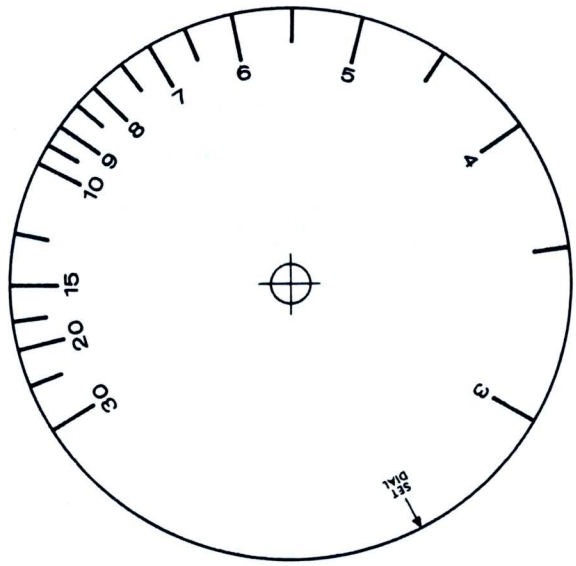
As may be seen, the instrument is housed in a compact case measuring 12in x 6in x 4½in, the front panel of the case being of the "wrap-around" type. The prototype case came from Heating Systems Pty. Ltd., of 24 O'Riordan Street, Alexandria, 2015, who designate it as type MC-9. This firm is also able to supply the calibrated frequency dial plate shown on the prototype.

The frequency dial is on the left of the front panel and consists of a calibrated circular plate mounted on a planetary reduction unit. A small fixed cursor fashioned from a scrap of acrylic sheet is mounted above the dial, permitting convenient and quite accurate adjustment.

In the centre of the panel (top to bottom) are the sine-square function switch, the output "fine" or "set level" control, and the frequency range switch. To the right of the last-named and underneath the output level meter are the coarse attenuator switch and the output terminals. Matching handles at either end of the panel permit convenient handling of the instrument, while also tending to protect the meter and control knobs from damage.

The meter is fitted with a face having three scales, the two uppermost scales providing the usual 10dB-related 0-1 and 0-3.16V ranges, while the lowest provides for relative dB measurements (FSD is +6dB). The face for the prototype meter was produced photographically from original artwork and duplicate copies are available to readers via the Information Service at 50c each. We understand that in due course the meters may be made available with this face fitted by the importer.

Inside the case of the instrument a majority of the minor components



The frequency dial of the new generator, which was calibrated using a Naunton 2 - watt potentiometer. The dial plate is obtainable from Heating Systems Pty. Ltd., who are also able to supply the case.

are mounted on a printed wiring board, which measures 10in x 5in. The board is mounted to the rear of the front panel by two small sheet-metal brackets which are fastened to the panel via the handle mounting screws. The ganged potentiometer which performs the oscillator tuning is also mounted on the board, being coupled to the rear of the planetary reduction drive via a flexible ¼in-to-¼in shaft coupling.

The buffer amplifier output transistors are attached to the wiring board via small spring clips, which, as mentioned earlier, provide additional area for thermal dissipation. The clips used in the prototype are of the type sold in most hardware stores for use as cupboard-door catches and as mounting clips for small tools and utensils.

The only minor components associated with the oscillator-amplifier circuitry proper which are not mounted on the board are the coarse attenuator resistors, which are mounted on the attenuator switch and supported by a dummy switch wafer, the attenuator compensating capacitor and the compensating capacitor wired between rotor and ground of the fine attenuator. Apart from these components there are

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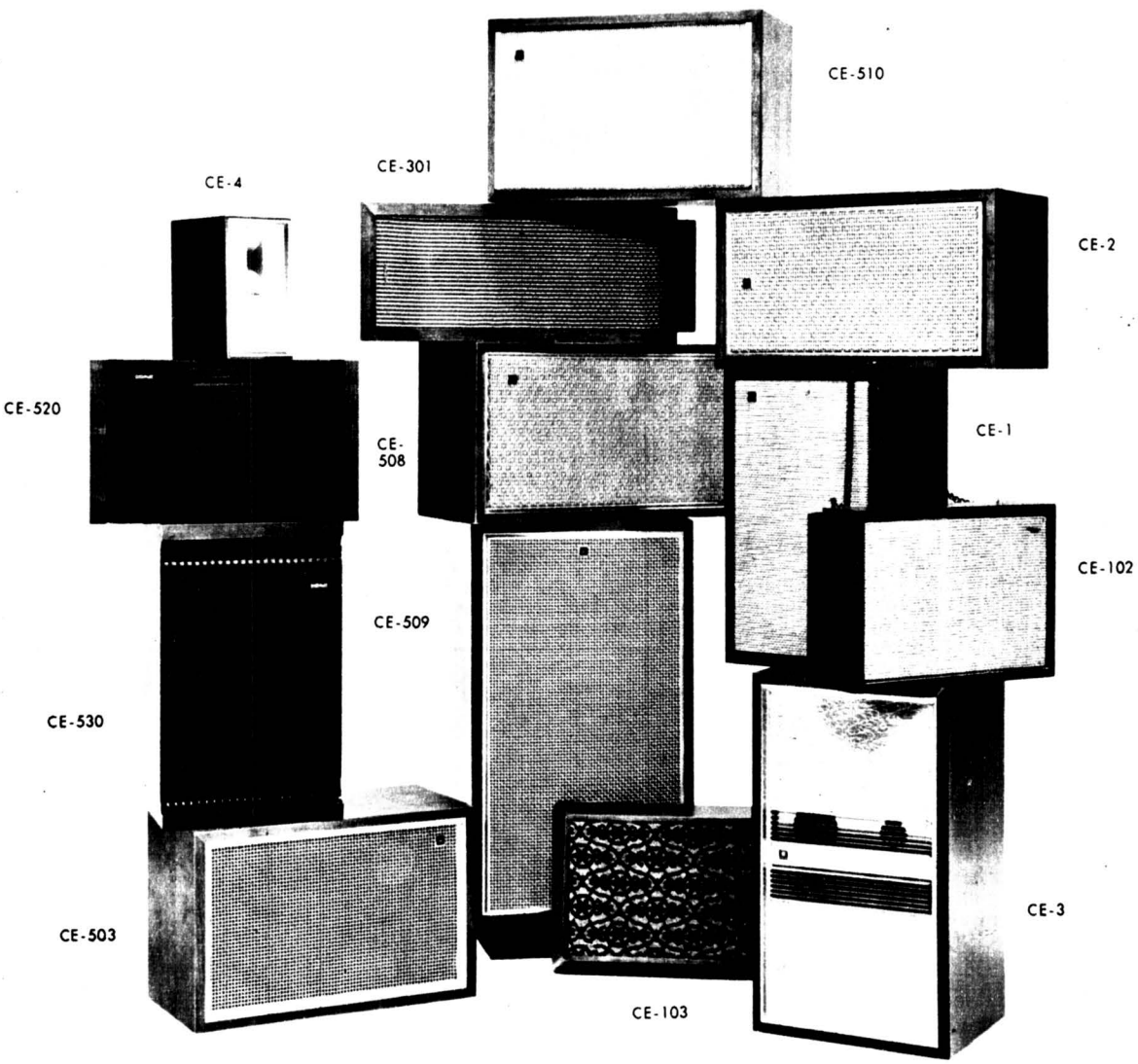

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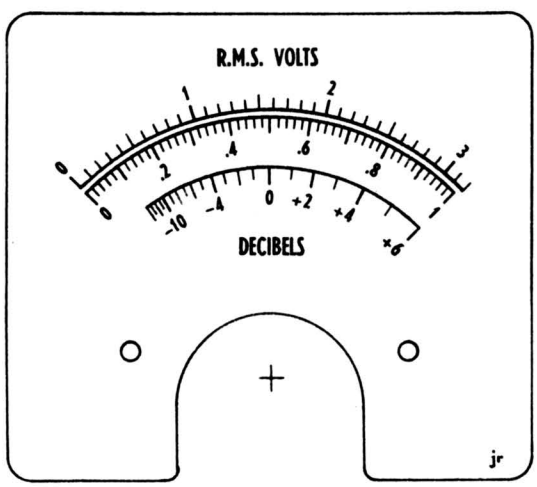
the metering components, which mount on a small section of miniature resistor panel attached to the rear of the meter, and the power supply components.

The power supply components are supported by an "L"-shaped metal bracket which mounts in the case at the rightside rear. The bracket is designed both to support and shield the supply from the oscillator and amplifier, and to this end the power transformer is mounted inside the bracket rather than on the outside. As the 2000uF filter electrolytic has a grounded can, this is mounted outside the bracket; however the remaining components fit comfortably inside supported as necessary by three tagstrips. A fourth 2-lug strip supports the 40408 radiator clip.

The construction and wiring of the instrument is straightforward and should be fairly clear from the illustrations and the foregoing description.



An actual-size reproduction of the prototype meter face, showing the three scales. The face is designed to suit a VP-2A meter as distributed by Electronic Supplies.

However, the following few points may help in ensuring that assembly is smooth and successful.

The wiring board is best wired up as the first step in assembly, after which the output attenuator may be wired and the connections made between the board, the frequency range switch and the attenuator switch. The meter circuitry may then be assembled on the rear of the meter, and finally the board mounted on its brackets and the connections made to the fine attenuator and function switch. The power supply section may be wired last, and in the interests of safety tested briefly before connection to the board.

Care should be taken when wiring the transistors and integrated microcircuit to the board, to ensure that these components are not damaged by overheating. A small, well-tinned iron is desirable, with the joints made thoroughly, but with heat applied for as short a period as possible. It is recommended that the transistor leads be cut not shorter than about ¼in, unless the constructor is well experienced in the art of printed wiring assembly.

To prevent possible vibration damage of the thermistor it is a good idea to anchor it to the board with a piece of cellulose tape after soldering it into circuit.

When the board has been attached to the front panel, the planetary reduction drive and dial may be assembled. Before tightening the flexible coupling overall accuracy of within 5 per cent, or to go to the trouble of calibration using a technique such as Lissajous figures. Which of these alternatives is taken will no doubt depend upon the calibration accuracy required.
connecting the drive to the tuning pot, ensure that the pot is turned fully anti-clockwise and that the dial is set accurately to the "set dial" arrow.

Once the instrument has been completed, the one remaining task is that of calibration and adjustment for optimum performance.

Frequency calibration of the instrument is most easily carried out with a digital frequency meter; in general this will also give the most accurate results. However, if a digital frequency meter is not available, the constructor has two alternatives: either to accept the calibration provided by the particular range capacitors and resistors employed, which will probably provide an

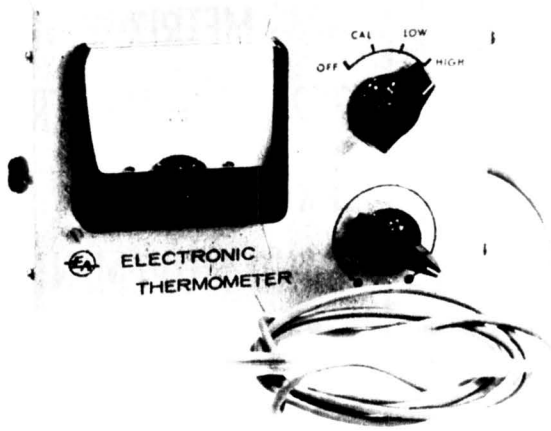
The low-end calibration of all of the ranges in common is determined by the ganged potentiometer, while the common high-end calibration is determined largely by the fixed series feedback resistor (shown on the circuit as 4.7K). The absolute calibration of each range individually is determined by the two capacitors concerned, while as mentioned earlier the small capacitor across the fixed feedback resistor largely determines the calibration at the high end of the uppermost range. These relationships should be borne in mind if it is found necessary to modify component values during calibration.

Adjustment of the oscillator operating point is necessary if the instrument is to give minimum distortion and this can really only be done by trial and error using a high-quality harmonic distortion meter or wave analyser. Measurements should be taken with a variety of values for the high value bias divider shunt (marked on the circuit with a diamond symbol) and from the values it should be apparent which value will give the minimum distortion.

Perhaps it should be noted in passing that the last-described adjustment will only be necessary when it is in fact made possible by the availability of the required instruments; if the instruments are not available, there should be no reason to perform the adjustment. It is likely that with no

(Continued on page 174)

For Our Beginners . . .



AN ELECTRONIC THERMOMETER

Here is a simple project which may serve either as an experimental project for a club or science class, or as an essentially practical one with a number of useful applications. It is an electronic thermometer, using a glass encaspulated thermistor as a temperature sensing element.

By John Horsfield and Philip Watson

The main advantages of this device are that it permits temperature to be monitored at a distant point, that the type of display can be much larger and easier to read than a conventional thermometer and that response can be more rapid than it is with a conventional thermometer. All these factors can be important in practice; much more so than might be appreciated by the simple noting of them.

One of the first applications that comes to mind is monitoring photographic solutions and, in fact, the practical version we will describe has been designed for this purpose. The main advantage here is simply that of convenience. A meter mounted at eye level is a good deal easier to read than a thermometer at bench level, particularly under safe light conditions. And the easier it is to read the temperature, the more likely it is that the operator will keep a close check on it—almost automatically.

Other applications which suggest themselves, and where the remote reading facility would be even more advantageous, are monitoring incubators and brooders in chicken hatcheries, or monitoring for frost in orchards and market gardens. We imagine that anyone who has faced the need for making such checks "on the spot" on a wet and windy winter's night would not have to be sold on this project.

The operation of the device is based on the resistance-temperature characteristic of the thermistor. The thermistor is a resistor with a high (negative) temperature coefficient, i.e., its resistance changes quite markedly with a change in temperature. The fact that the change is negative (resistance decreases as temperature increases) is of less importance in this case, but can be quite valuable in other applications.

The circuit is quite simple, being basically a bridge configuration. An elementary circuit is shown in figure 1, where the bridge consists of four resistors, R1, R2, R3 and R4. Resistors 1, 2 and 3 are conventional types, preferably chosen to have the lowest possible temperature coefficient. Resistor R4 is the thermistor.

Under certain conditions such a bridge circuit can be said to be "balanced," i.e., there will be no potential difference between points "A" and "B," nor current through the meter, and therefore no reading. Such a balanced condition can exist if: (a) all four resistors are equal in value, (b) R1 and R2 are equal and R3 and R4 are also equal, but differing from R1 and R2, or (c) R1 and R2 differ, but R3 and R4 also differ by the same ratio.

If these conditions are not satisfied, the bridge will be unbalanced and the meter will deflect in a direction and to an extent dependent on the conditions causing the unbalance. For example: Let us assume that R1 and R2 are equal. The bridge will now balance if R3 and R4 are equal, but let us consider what happens if R4 is less than or greater than R3. If R4 is less than R3 then point "A" will be closer to the positive end of the system than point "B" and the meter will read up the scale. If R4 is larger than R3, the reverse reasoning will apply and the meter will try to read down the scale.

To make use of these characteristics in our application, imagine again that we start with R1 and R2 equal. We then determine the resistance of the thermistor R4 at the lowest temperature we wish to measure and make R3 the same value. Thus the bridge will balance when the thermistor is at minimum temperature, and we can calibrate the meter zero position as being equal to the minimum temperature.

As the temperature of the thermistor increases, its resistance decreases. This moves the point "A" toward the positive end of the network, making it positive with respect to "B", and the meter moves up the scale. How far it moves for a given change depends on the sensitivity of the meter, the voltage of the battery, and the value of R5. Within certain limits, we can select these so that full-scale deflection of the meter corresponds to the maximum temperature we wish to measure. We can thus calibrate this point. And, if we can assume that the temperature coefficient of the thermistor is linear, we can also calibrate all points in between.

So much for the broad theory. Now let us consider practical components and values. There are a number of thermistors available which could be used in such a circuit, but our experiments have been conducted around one specially designed for immersion in liquids. It is the type F23, and consists of a glass tube 3/32in diameter and 3in long. The thermistor element proper is sealed in a small glass bead at one end of the tube and connecting leads emerge from the opposite end. The tube may be immersed in a tray or tank in the same manner as a conventional thermometer.

These thermistors are handled by Standard Telephones and Cables Pty. Ltd., who also supplied a basic thermometer circuit from which we developed our unit.

To achieve a useful order of sensitivity without resorting to excessive voltage it is necessary to use a 50uA meter. This may have been a prohibitive requirement at one time, but there are currently available good quality imported meters of this sensitivity at attractive prices.

The choice of this meter sensitivity is based on the use of a 1.5V battery. While a higher voltage would permit the use of a less sensitive meter, we are limited in this regard by the dissipation in the thermistor. This is not so much a matter of exceeding the dissipation rating as of producing any significant temperature rise in the thermistor, which would falsify the reading. With the circuit and values shown, the maximum power dissipated in the thermistor (full-scale deflection) is of the order of 0.25mW, insufficient to cause serious error.

More precisely, the "F" series thermistors are quoted as having a dissipation constant of 2.5mW/°C in water (0.85mW/°C in air). Assuming the use of water (or similar liquid) the error introduced by a dissipation of 0.25mW would be only 0.1°C, and even this is largely offset by the calibration procedure.

The power supply may be a battery as we have indicated, or a simple power supply, such as we will describe later. Provided the unit does not have to run continuously, the battery would appear to be the better proposition in terms of first cost, portability, and convenience. At 1.4V, current drain is about 2.5mA, and an alkaline type penlite cell ("AA" size) should provide about 1000 hours operation. Even

if used for, say, 10 hours per week, it should last approximately two years, which is also within the normal shelf life of these cells.

Working at near maximum sensitivity the circuit shown will provide a range of about 25°F. and this gives reasonable scale expansion. If using a normal 50 division scale each division would equal 0.5°F. If working to a centigrade scale is would be easy to modify the coverage slightly to one which would fit in with the 50 divisions. For example, a spread of 12.5°C would give four divisions per degree C.

Reducing the sensitivity will increase the coverage, but give a more compressed scale. Conversely, anything which increased the sensitivity, such as a more sensitive meter, a larger battery, etc., would provide a more expanded scale. As we have seen, there are practical limits to these factors, but we have considered the possibility of amplifying the signal before applying it to the meter. Assuming that this could be done satisfactorily it might be possible to expand the scale to the point where it indicated only a few degrees either side of a critical value. However, this is something for the future.

As already suggested, the particular range to be covered is selected by, first, nominating the low temperature limit and providing a value of R3 to match the thermistor resistance at this temperature, then adjusting R5 to give full-scale deflection when the thermistor is at maximum temperature.

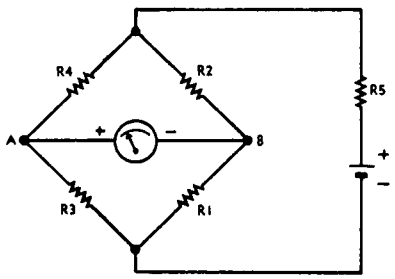
Because of the normal spread of thermistors, it is not possible to nominate an exact value for R3, although we can make a rough approximation from the published data, usually in graph form. Final adjustment and selection of resistance values must be made by direct comparison with a reliable thermometer. The resistor may then be adjusted either by adding series of parallel resistors, or by making part of the resistance adjustable.

Our final circuit shows a combination of fixed and variable resistance designed to cover the likely spread of thermistor values at the particular minimum temperature. However, for this or other ranges, there would be some advantage in using, initially, a larger value variable resistor, say 5K, from which the approximate value can be determined experimentally. This will also permit a better combination of fixed and variable resistance for R3 in its final form, with the variable portion made as low as possible for easy adjustment.

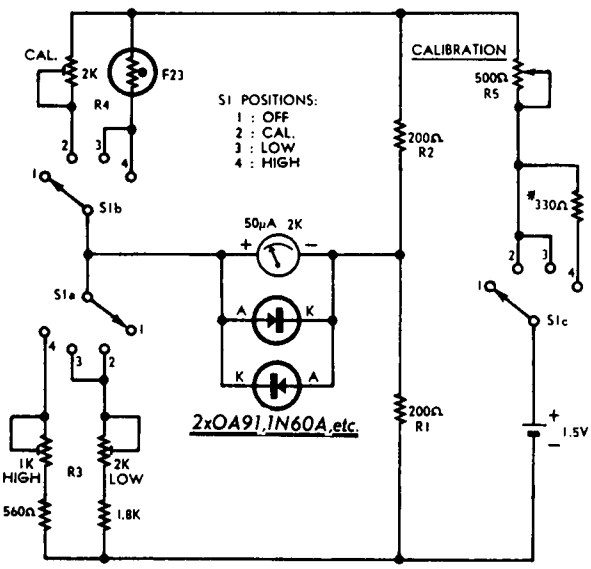
Adjustment of R5 is provided by substituting, for the thermistor, a conventional resistor having the same resistance value as the thermistor at the full scale temperature. R5 is then adjusted until the meter reads full scale, left on this setting, and the thermistor restored to the circuit in place of the substitute resistance.

This latter arrangement also provides a convenient method of checking the calibration of the instrument to take care of minor changes in battery voltage. In the practical version we provide a multi-position switch which provides this calibrate facility as the first step from the "OFF" position, followed by the active range of ranges. Thus one is automatically reminded to calibrate the instrument every time it is switched on.

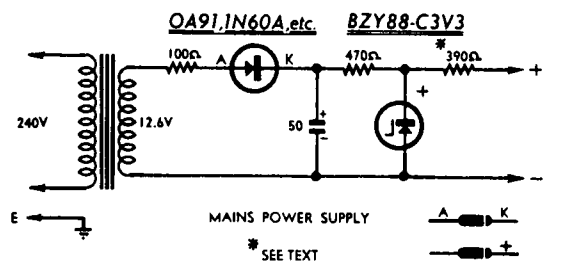
The unit we built was designed for photographic use and covers from 55°F to 80°F (12.5°C to 27.5°C). This is about the minimum range the system can cover, even though it may be a greater range than is strictly required. Individuals may also have different ideas about how this range should be distributed about the nominal working temperature of 68°F (20°C). Some may prefer to move it bodily upwards, say 60°F to 85°F (15.5°C to 29.5°C approx.), and this could be done quite easily by selecting R3 and R5 as already discussed.



Above: The basic bridge circuit around which the electronic thermometer is designed. Study this carefully in conjunction with the explanation in the text.



Right: A practical circuit as finally evolved. Although more components are involved, the circuit remains basically the same. Note that the "R" numbers shown, correspond to those in the basic circuit, but now apply to groups of resistors performing the same function.



ELECTRONIC THERMOMETER

Reference to the practical circuit will show how the various features are provided. A four position panel switch selects "OFF," "CALIBRATE," "LOW" and "HIGH" in that order. The "OFF" position is self explanatory, the main function being to open the battery circuit. In the "CALIBRATE" position the battery is switched on and the bridge circuit operates in the normal manner, except that a resistor is substituted for the thermistor. The value of the resistor is made equal to that of the thermistor at the full-scale temperature (Lower range). The calibrate pot (R5) is then adjusted for full-scale reading.

In the "LOW" position the thermistor is switched into circuit and the instrument is ready for use.

The "HIGH" position is a purely optional one and, if there is not a specific need for it, the instrument may be made a good deal simpler by omitting it. If it is included, the switch is used to select a new value of R3, representing the thermistor resistance at the low end of the new scale, and to add a resistor in series with the calibrate pot. The value of the latter is selected so as to give the required full-scale reading on the high range, when the calibrate pot is correctly set for the low range.

We have not provided a calibrate facility on the high range, in the interest of simplicity. While, in theory,

(Note that the above Centigrade values are not necessarily exact conversions from Farenheit. Practical scales have been modified to provide a logical order of division and some decimal values have been rounded off.)

We have also provided a second range, which the reader may regard as optional. This covers from 110°F to 160°F (45°C to 70°C) and is intended mainly to cover the temperatures required when mixing solutions, usually around 125°F (51°C). These temperatures are not particularly critical, but one that is too low may make mixing unnecessarily difficult and tedious, while one that is too high may prejudice the keeping qualities of some formulas. If you feel that you cannot judge the required temperature with your finger, this extra range will prove useful.

this may make the high range slightly less accurate than the low range, the error is not serious for the kind of work envisaged. Should it be considered desirable, a completely separate calibrate pot, could be fitted, and selected by the same switching function.

Resistors R1 and R2 are 200 ohm, and are wire-wound types in the interest of long-term stability. For the low range position R3 is made up of a 1.8K fixed resistor and a 2K adjustable type. For the high range it is a 560 ohm fixed and a 1K adjustable The fixed resistors are wire-wound types and the adjustable ones are wire-wound "tab" type on a straight former. These are a good deal cheaper than conventional circular wire-wound type.

Another feature of the practical circuit is the provision of two diodes across the meter. These are intended to protect the meter from overload in the event of a fault causing a serious unbalance in the bridge. While not essential, this protection is so simple and inexpensive that it would seem foolish not to provide it.

The physical form which this unit takes is not particularly important. There are no leads which are critical in regard to length or dress, no heat to cause ventilation problems, and only a few components to be accommodated. It can be built into almost any small metal box.

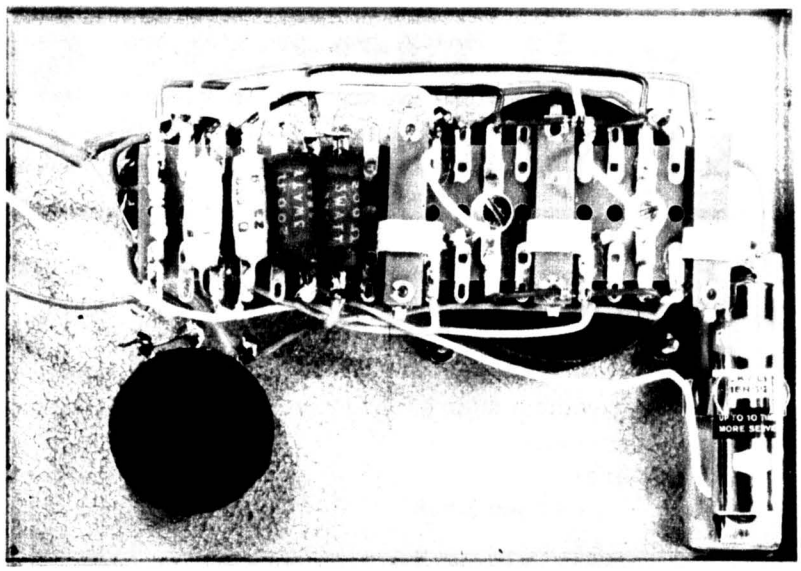
Our unit was constructed in a readily available commercial box measuring 6½in x 4½in x 2in (deep). The complete unit could be mounted on a wall, at eye level, above a darkroom bench. As shown, our unit is fitted with both a small power supply and a battery holder, but it is more likely that most users will require only one or the other of these. In most cases, battery power will be perfectly satisfactory, at least for a start, but there is room in the case for the power supply if it is required.

As can be seen from the photograph, most of the components are mounted on a length of miniature tagstrip, 19 terminals long. This is supported on the two meter terminals at one end, and by the switch at the other end. A short length of heavy tinned copper wire, running from a switch terminal to a terminal on the tagstrip, provides the support in the latter case.

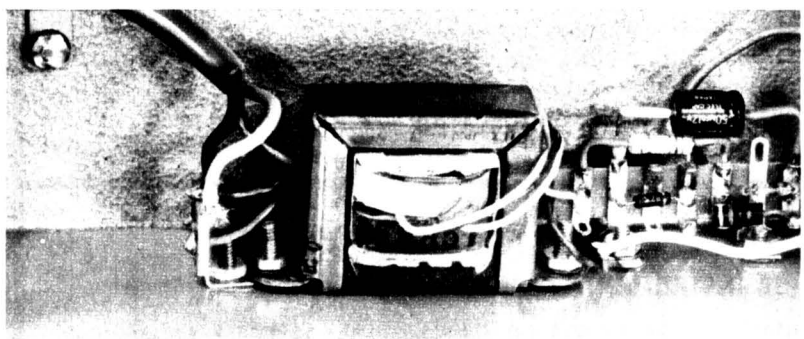
The switch is a three-pole, four-position type from the "Jabel" range, although other types having the necessary contact arrangement could be used, provided they could be accommodated.

One problem which confronted us was to provide a suitable method of holding and making contact with the battery. One suggestion is to solder the leads directly to the battery terminals, in which case the battery can be secured by any simple means. On the basis that the battery will need to be replaced only at infrequent intervals, such an arrangement should not be too irksome.

The main objection to this arrangement is that it is not usually regarded as good practice to solder to the manganese-alkaline type battery. One manufacturer conceded that it could be done provided one used a very hot iron, prepared the surfaces carefully by cleaning and fluxing, and completed the job with one quick application of the iron. However, they were not particularly happy about giving the idea their blessing.



The complete unit, for battery operation, is mounted on the front panel of the box. The three adjustable resistors are clearly visible and are, from left to right, "HIGH, "LOW", and "CAL." Note the manganese-alkaline cell at lower right.



If a power supply is to be used in place of a battery it is built in the bottom of the box. Only a few components are involved.

On the other hand there do not appear to be any ready-made battery holders available on the market, at least not to accommodate a single cell, or even two cells. In view of the increasing popularity of the manganese-alkaline cells, and their undoubted advantages for applications of this kind, a suitable holder is something we would like to see on the dealers' shelves.

In the meantime, we had to improvise something. Our first inspiration came as we pulled a screwdriver from a tool clip on the side of the bench. We suddenly realised that a suitable size clip of this type could solve at least half our problem; that of holding

PARTS LIST

1 Instrument case, 6½in x 4½in x 2in with wrap-over front panel.
1 Thermistor, type F23 or similar.
1 50uA panel meter, 3in square rectangular type.
1 3-pole, 4-position switch.
1 19-pair miniature tag board.
1 Manganese-alkaline cell, 1.5V (for battery version only).
1 Holder for cell (see text).
2 Control knobs.
2 Diodes OA91 or similar.

RESISTORS

2 200 ohms WW.
1 330 ohms ½w (see text).
1 500 ohms potentiometer WW.
1 560 ohms WW.
1 1K WW slider pot.
1 1.8K WW.
2 2K WW slider pots.

MISCELLANEOUS

Coaxial cable or similar 2-conductor cable (for thermistor connection), connecting wire, sleeving, grommets, solder tags, nuts, bolts, washers, self-tapping screws, etc.

MAINS POWER SUPPLY

1 Power transformer, pri 240V, sec 12.6V.
1 3-tag strip.
1 7-tag strip.
1 Diode OA91 or similar.
1 Zender diode BZY88C3V3 or similar 3.3V type.
1 390 ohms ½W resistor. (See text).
1 470 ohms ½W resistor.
1 50uF, 12V electrolytic capacitor.
Mains power cable, mains plug, cable clamp.

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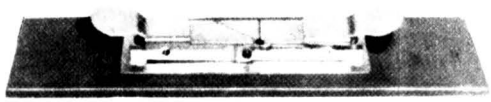

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the cell securely between spring contacts. A quick check on the sizes available, confirmed that this was one which was ideal for the "AA" cell.

We still needed something for the actual contacts. Another look at the tool clip suggested that it might serve in this role also. Each half of the clip is just the right shape to serve as a contact, as well as having the necessary spring and a plated finish. So this is what we used. In fact, each contact consists of slightly more than half a clip, the whole of the bottom section being retained to provide a mounting hole.

In some applications, such a battery holder could be assembled on an existing terminal board, but we found it more convenient to make this one as a separate unit, using as a base a short strip of 3/8in plywood. The holder and contacts are secured by countersunk brass machine screws, the countersunk heads being recessed slightly into the underside of the plywood strip and the contacts secured with a nut and lockwasher. Ordinary 1/8in screws are used, ¼in or 5/8in long.

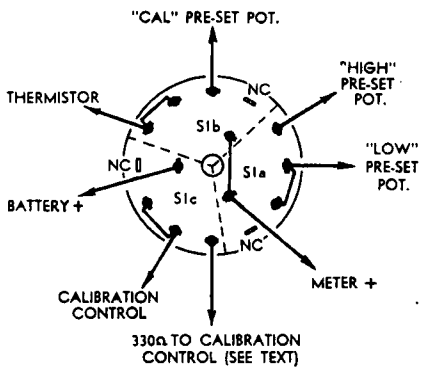
The thermistor needs to be housed in some kind of probe to protect it from damage. A piece of glass or rigid plastic tubing is very suitable, and we used the plastic body from a discarded ball point pen. To ensure that there will be a flow of liquid around the sensitive tip of the thermistor it is wise to select a tubing with a bore somewhat larger than the diameter of the thermistor. Also, in the case of plastic tube, to drill one or two holes through the side wall an inch or so above the tip of the thermistor. This will eliminate any risk of an air lock. Note that the type of plastic used should be able to withstand the highest temperature likely to be encountered

Where the probe is to be used in a developing tank it is a good idea to try to house it in a stirring rod which will suit that particular tank. In many cases it is possible to buy spare stirring rods, and one of these could be modified to house the thermistor. Alternatively, some stirring rods are made to accommodate a conventional thermometer, and these would be even more suitable for modification.

The power supply is a very simple arrangement, the main requirement being to use a transformer small enough to fit into the metal case. We used a Ferguson type PF2851, which is one of the smallest available. We also tried a PF2315 and an A & R type 5579. Both can be accommodated, though the latter is rather a tight squeeze, due to the terminal board on top.

Whatever kind of transformer is used, make sure that the mains leads to it are securely terminated, and that a strain clamp is provided to securely anchor the mains cable.

The circuit of the power supply involves a half-wave rectifier, a 100-ohm resistor to protect the rectifier from excessive surge current, and a 50uF filter capacitor. Following this is a 470 ohm resistor and a 3.3V zener diode, which function as a voltage



Showing how a Jabel type switch should be wired before the terminal board is added.

regulator. Finally, the 390 ohm resistor reduces the voltage to approximately 1.5. In the event that one unit might be used with either a battery or a power supply, at different times, this resistor could be adjusted to maintain the same calibration in both cases.

As suggested earlier, calibration should be undertaken with the aid of a good quality conventional thermometer. Strap the thermistor to the body of the thermometer with insulation tape, locating the tip of the thermistor and the lower end of the thermometer at the same level. The whole combination is then immersed in water and the water heated or cooled as required to give the necessary temperature check points.

Assuming that the unit is to cover the same ranges as we have suggested it would appear to be perfectly practical to use the same scales, and we have reproduced these in actual size. Photographic reproductions will be available for the usual 50c fee, and these can be pasted on the rear of the existing meter scale and the scale re-fitted with the new markings face up. In this case calibration should not involve anything more than a check at both ends of the scale, and at the centre.

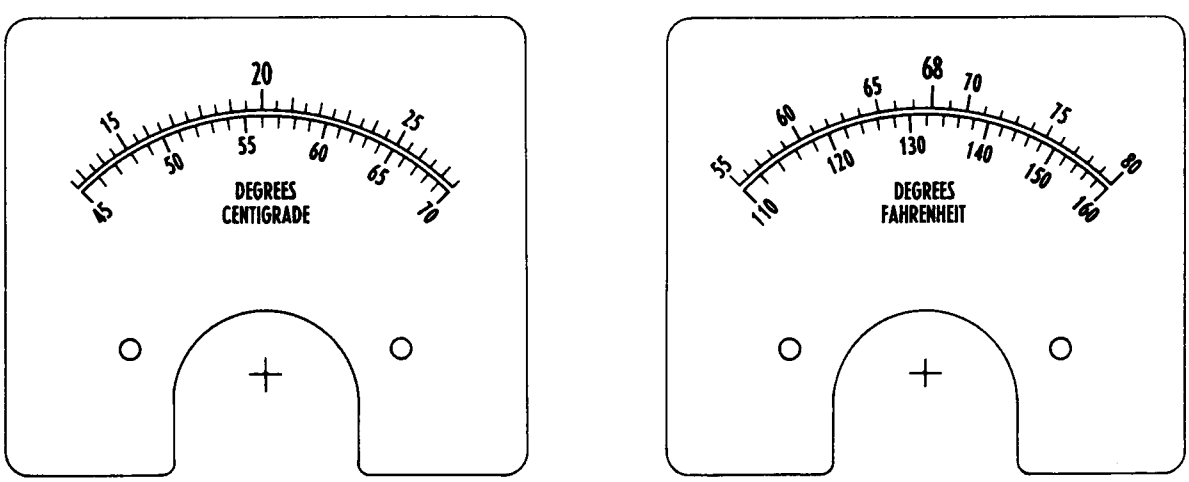
If a different scale is required, then the constructor will have to prepare it himself. At the lower temperature ranges, such as the "LOW" range on our model, and below it, the thermistor response is fairly linear, and an existing linear scale, with a suitable number of divisions, will probably give sufficient accuracy if calibrated at each end. At higher temperatures the thermistor becomes progressively non-linear and a specially prepared scale, based on a large number of readings, will be needed.

To obtain these readings we immersed the thermometer/thermistor combination in a beaker of water, which was then mounted in a crude "hot box." This was a cardboard box in which was mounted a lamp holder and 100W lamp. A circular hole in the top of the box allowed the beaker (which was tapered) to be held with about three-quarters of its depth inside the box.

For lower than ambient temperatures we added ice until the required level was reached or slightly exceeded. Then, as the water moved back towards ambient, readings were taken at appropriate intervals. As the ambient level was approached, and the rate of change decreased, the lamp was switched on and allowed to take the temperature past ambient and on to the maximum value. After the lamp was switched off, and the temperature dropped, check readings were made, with ice added to complete the lower portion. The procedure can be repeated if it is felt that it is necessary.

During all these tests it is important to ensure that the water around the thermometer is at the same temperature as that around the thermistor. In spite of their being close together, differences can occur, and it is advisable to stir the water bath whenever a precise comparison is to be made.

(Continued on page 174)



Two meter scales, one Farenheit, one Centigrade, to suit the meter we used. These are actual size, but photographic copies are available.

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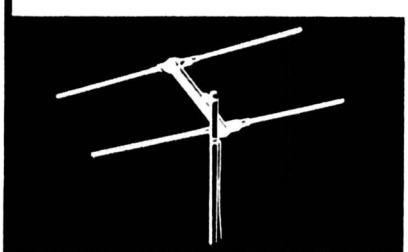

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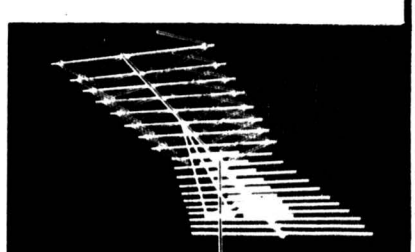

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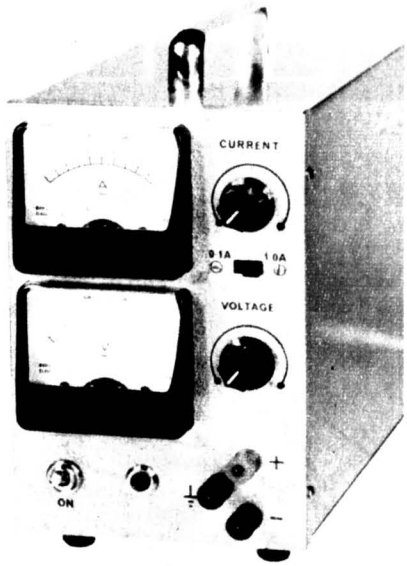
A Lab-quality Regulated Supply

Described in this article is a fully protected transistor-regulated power supply providing adjustable output voltage from 0 to 30V, at a current of up to 1A. With regulation better than 0.5 per cent and full metering facilities, it is equipped with an output current cutoff control which can be adjusted from 20mA to 1A in two ranges.

by ANTHONY LEO



SPECIFICATIONS

A transistor regulated power supply having a fully floating output adjustable from 0 to 30 volts at a maximum current of 1 amp.

Output current limiting is provided, which is adjustable from 20mA to 1A in two ranges, 0-100mA, and 0-1A.

Load and Mains Regulation: Better than 0.5 per cent.

Ripple and Noise: Less than 2mV peak to peak.

Metering: Two meters are provided for monitoring output voltage and current. Current is metered in two ranges which are switched with the current limiting range switch.

With the wide range of semiconductor devices at his disposal for electronic circuit fabrication, the development engineer or technician — and the hobbyist—often requires a wide range of power supply voltages. Previously, transistors were regarded as being low voltage devices, rarely requiring more than 12 volts; however, this is no longer the case.

Nowadays the required supply voltages range from as low as 3.6 volts for digital integrated circuits, up to 300 volts and more for transistors used typically in television deflection circuitry. Hence, an ideal all-purpose power supply would perhaps deliver from 0 to 300 volts, and be capable of supplying a current of one amp and sometimes more. It is fairly obvious that the total load capacity of such a supply would be around 300 watts, making it rather an impractical and uneconomic proposition.

In fact, it would seem that such voltage extremes are only required for the more specialised and infrequent semi-conductor applications. For more general use in a service shop or development laboratory a much smaller voltage range will normally be sufficient. A range of from 0 to 30 volts, at 1 amp, will typicaly represent a much more practical compromise for use with low to medium power audio and video circuitry.

In addition to these requirements, voltage regulation of the order of one per cent would be quite sufficient in these applications, as in general extremely small load voltage variations are usually not critical. With transistor regulated power supplies filtering against ripple voltage is also important —and quite easily provided; a ripple component figure of less than 10 millivolts P-P is quite common.

Short circuit protection may be considered as essential in a general purpose supply, with an associated adjustable over-current limiting facility being desirable. Provided with this over-current facility, the adjustable power supply may be set up to meet comfortably the requirements of a normal load. If an abnormal load condition should develop, the supply will then automatically limit the output current to a safe level for maximum protection of both the power supply and the load.

In recent commercial power supplies provision has sometimes been made for externally "programming" the output voltage and/or current, by means of a programming resistance or voltage. Such a facility can be used to make the supply a slave to a master control source. However, in the context of a general-purpose variable bench supply this would not be required.

The usefulness of a regulated power supply with variable output voltage is not so much that it provides a greater or lesser degree of voltage regulation, but simply that it is a source of variable voltage. The sheer convenience of being able to "dial" any voltage between say 0 and 30 volts is unquestioned.

Probably the only alternative would be to have a series of batteries to supply (at low impedance), the various voltaeges often required. But this would be rather consuming of space on the work bench; continued replacement over a period of time can also be surprisingly expensive.

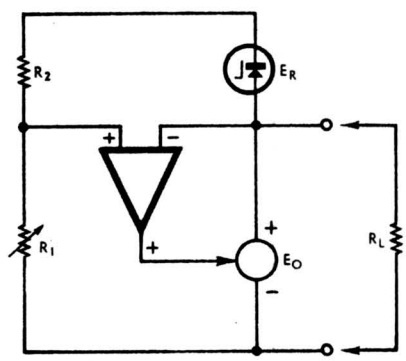
Even when not in constant use, batteries have a limited life dependent upon their size and construction. Further, the voltage regulation of batteries tends to deteriorate well before they have outlived their nominal usefulness.

On most occasions, some degree of voltage regulation is needed, with more precise regulation being required less frequently. A higher degree of regulation is usually required when making power measurements and fabricating various forms of control circuitry.

Several transistor regulated power supplies of fixed and variable output voltage have been described previously in the magazine. Some of these supplies have included overload protection for both supply and load, while others have not, depending upon economy, complexity and application requirements.

Of the supplies described thus far, two were provided with the variable voltage facility and, of these, one had over-current and short circuit protection. The first supply, which was described in April, 1962, supplied voltage from 0 to 15 volts at a current level of up to 1 amp. However, for reasons of economy and simplicity it was not provided with short-circuit protection.

The second supply, which in a sense superseded the first was described in April, 1966. While it was capable of delivering a maximum current of up to only 500mA, this supply was equipped with over-current protection and had an extended voltage range up to 25V. However, the output voltage of the supply could not be brought down to less than 6 volts.



$$\frac{R_1}{R_2} = \frac{E_O}{E_R}$$

$$E_O = E_R \cdot \frac{R_1}{R_2}$$

Figure 1

In recent months, reappraisal of the performance of the 1966 supply has been found necessary in the light of recent developments in semi-conductor technology. The advent of various linear and digital integrated circuits has brought a requirement for lower output voltages than 6V, while developments in discrete components have shown the limitations of both a 25V maximum voltage and — more particularly — of a maximum current rating of only 500mA.

While the new supply to be described in this article will probably meet most requirements of both the home constructor and development worker alike, a price has to be paid for the higher order of performance.

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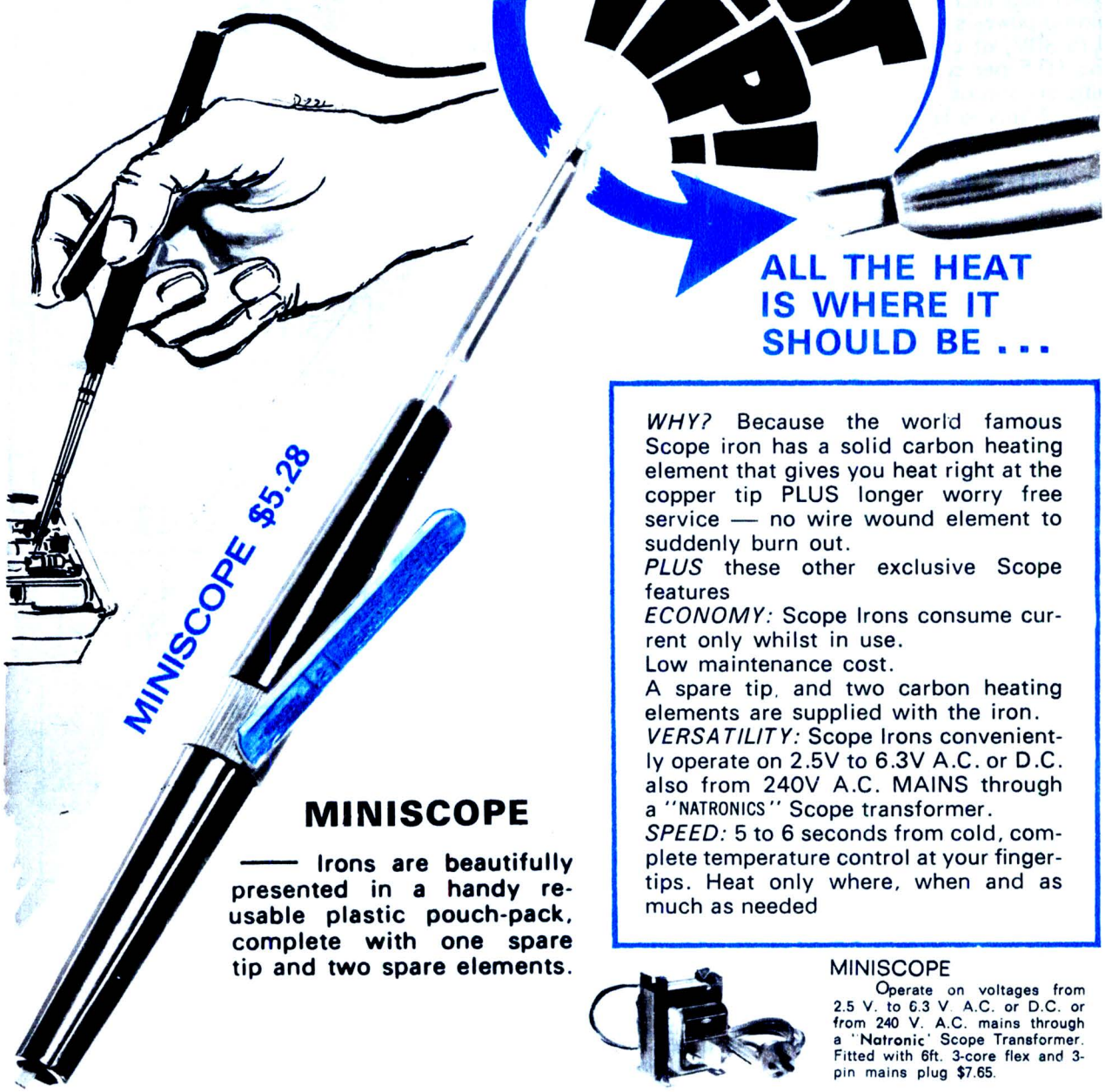

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In addition to the increased complexity of circuitry and operating functions, the overall cost will be a major factor determining the suitability of the supply in a particular application. However, we expect that the cost of the instrument will compare more than favourably not only with similar commercial units, but also with our 1966 design.

The circuit techniques and operating principles employed in this design are to some extent a departure from those normally used in moderate-cost power supplies, being derived from the techniques used in high performance designs. This has been found necessary in order to achieve a high order of performance at a reasonable cost. As a result the operating principles of the supply may not be immediately clear at first glance, but in fact they are quite easily appreciated.

An insight into the operation of the regulator may be gained by referring to figure 1, which represents the supply as a balanced bridge. The arms of the bridge are formed on one side by voltage sources Er and Eo, and on the other by resistors R1 and R2 in series.

Er is the constant reference voltage source, symbolised for convenience by a zener diode; while Eo is a controllable DC voltage generator which represents the final output of the power supply. The triangle shown between the arms of the bridge represents an error sensing amplifier, together with the usual series regulator transistor.

When the bridge is balanced, the voltage across R1 will be equal to Eo and similarly the voltage across R2 will be equal to the reference voltage Er. Hence, we may write the expression R1/R2 = Eo/Er showing that the output voltage Eo is proportional to the ratio of R1 and R2.

However, if the bridge becomes unbalanced by the application of a load to the output voltage generator, causing Eo to be reduced instantaneously, the voltage across R1 will be slightly more positive than Eo. The difference or error voltage between R1 and Eo will then appear as an error signal at the input to the differential amplifier. The resultant amplified error signal is then applied to the generator Eo, in opposite phase, as a correction signal. The output voltage will thus tend to be restored to the value corresponding to bridge balance.

The phase relationships of the differential amplifier inputs are indicated with a plus and a minus sign, with the output positive by convention: no phase inversion is understood to occur in the generator Eo. Hence falling or negative - going voltage at the negative input to the amplifier will cause its output voltage, and hence the voltage Eo, to rise. Conversely a positive-going voltage at the negative input, corresponding to a rise in Eo, will cause the amplifier output to fall and restore Eo as before.

It may be seen that the bridge configuration is potentially capable of providing a high degree of voltage regulation; however it also offers a convenient means of programming the output voltage. If we reduce the value of R1 and hence the ratio R1/R2, then the output voltage Eo will be reduced accordingly, by the action of the error amplifier, as shown in the second equation in figure 1. Hence the circuit may be programmed to produce a particular output voltage simply by presenting it with the corresponding value of R1.

An elementary schematic of the power supply, as a complete unit, is shown in figure 2. For simplicity, the power transformer and rectifiers are shown in block form and triangles are used to represent voltage amplifiers.

Comparing the schematic diagram of figure 2 with that of figure 1, several refinements will be noticed. The output voltage generator Eo has been separated into two components: an error sensing voltage amplifier, and a series regulator transistor supplying the output power. A further refinement is the provision of short circuit and over-current protection which, in elementary form, consists of a current sensing resistor Rs and a voltage amplifier which is arranged to shunt progressively the zener reference voltage, bringing it to zero in the event of a short circuit.

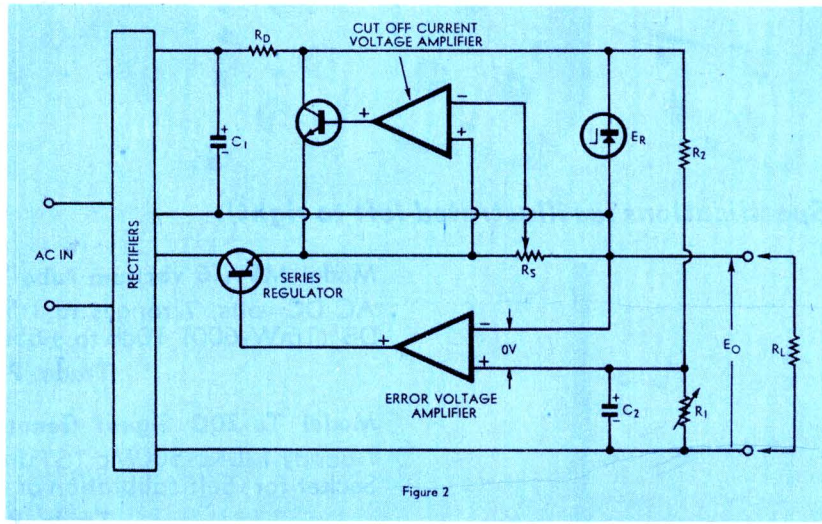

Figure 2

In effect, the protection circuitry operates to make the supply a source of constant current regardless of load variations. This is achieved because the reference voltage Er becomes proportional to the voltage developed across the sensing resistor Rs. It may be seen that by varying the input voltage fed to the cutoff amplifier, from Rs, the output current fed into any load (even a short circuit) may be set to a predetermined value.

While there would not be many applications for the supply as a pure source of constant current, the facility to program the supply for constant voltage up to a particular maximum value of load current, and then have it switch to a "cutoff mode" wherein it maintains constant current, provides valuable protection for both the supply and the load. Without undue complexity, the cutoff current level can be made continuously variable from as low as 20mA up to 1A.

Normally the current sensing resistor in series with the emitter of the voltage regulating transistor would cause loss of regulation, particularly at higher current levels. However, by correctly arranging the connection of the inputs to the voltage regulator error amplifier, any tendency to lose regulation can be compensated by the inherent negative feedback of the regulator bridge.

The negatively phased input to the error amplifier is taken directly to the positive output terminal, so as to include any resistance in series with the regulator transistor in the feedback loop.

In power supplies of this type designed for more precise regulation, provision is often made for external error sensing connections. This enables both input terminals of the error amplifier, together with the programming resistor, to be connected directly at the load to correct for any voltage losses in the leads between the supply and the load.

A situation requiring such a facility is one where a heavy load has to be considerably removed from the supply terminals, for example, in environmental testing applications. Large currents can produce appreciable voltage losses in extended lengths of cable, and without the facility for remote sensing the load voltage regulation would suffer.

This situation will seldom tend to arise with a supply such as the present one, intended to deliver currents only up to the order of one amp. Furthermore, the present supply is not designed to provide such extreme regulation that would categorise it as a laboratory instrument of the type suitable for such specialised application. Consequently, we have decided that the additional expense incurred with external error sensing is not at present justified.

In fact the supply is capable of a high degree of voltage regulation, of the order of 0.5 per cent and better. This, coupled with its overall cost, should certainly make it a very attractive unit for use not only in development applications but also in the home workshop and amateur "shack."

A further feature of the supply is the extremly small ripple voltage at the output — less than 2mV P-P at full load, which is achieved by means of electronic filtering.

Since, by emitter follower action, the output voltage of the regulator transistor is essentially the same as the voltage applied to its base, the ripple appearing at the output will be determined by the ripple component of the control voltage applied at the base by the error amplifier. It follows then that the effective fitering of the output voltage will be determined, ultimately, by how well we filter the reference voltage supply.

Components effecting the filtering of

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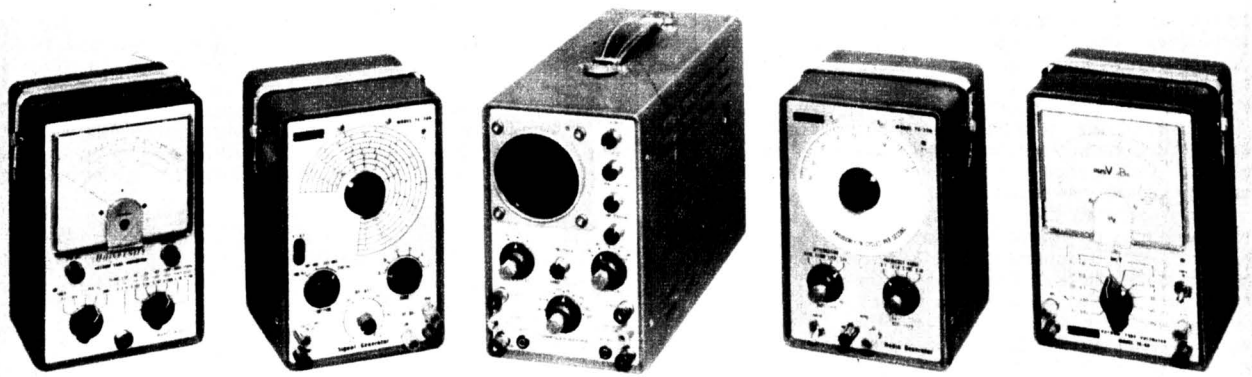

Specifications (as illustrated left to right):

Model MVA-6 vacuum tube Voltmeter

AC-DC volts, 7 ranges to 1.5KV; P.P. volts, 7 ranges to 4KV; DB (1mW-600) 10db to +65db; ohms .2Ω to 1000MΩ.

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7 Bands 120Kc-500Mc (6 Fundamental and 1 Harmonic) Xtal Socket for: Self calibration or Marker Generator.

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Model UC 3 3" Oscilloscope

Vertical 100mV P.P./CM (at 1Kc) Freq. Char. 1.5 cps to 1.5 Mos Horizontal 900MV P.P./CM (at 1Kc). Wide sweep 10 CPS —300Kcs Continously variable.

Trade Price $100.00

Model Te 22D Audio Generator.

Sine 20 cps-200Kcs. Square 60 cps-30Kcs. Output 7V max (1K imp) Freq. response + 1.5db 60 cps-150Kcs.

Trade Price $38.00

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Ac volts 1m V-300V 10 ranges. db range-40 to +50db 10 ranges Input impedance 10 meg. Accuracy 5 cps-1.2 Mcs. ± 2db.

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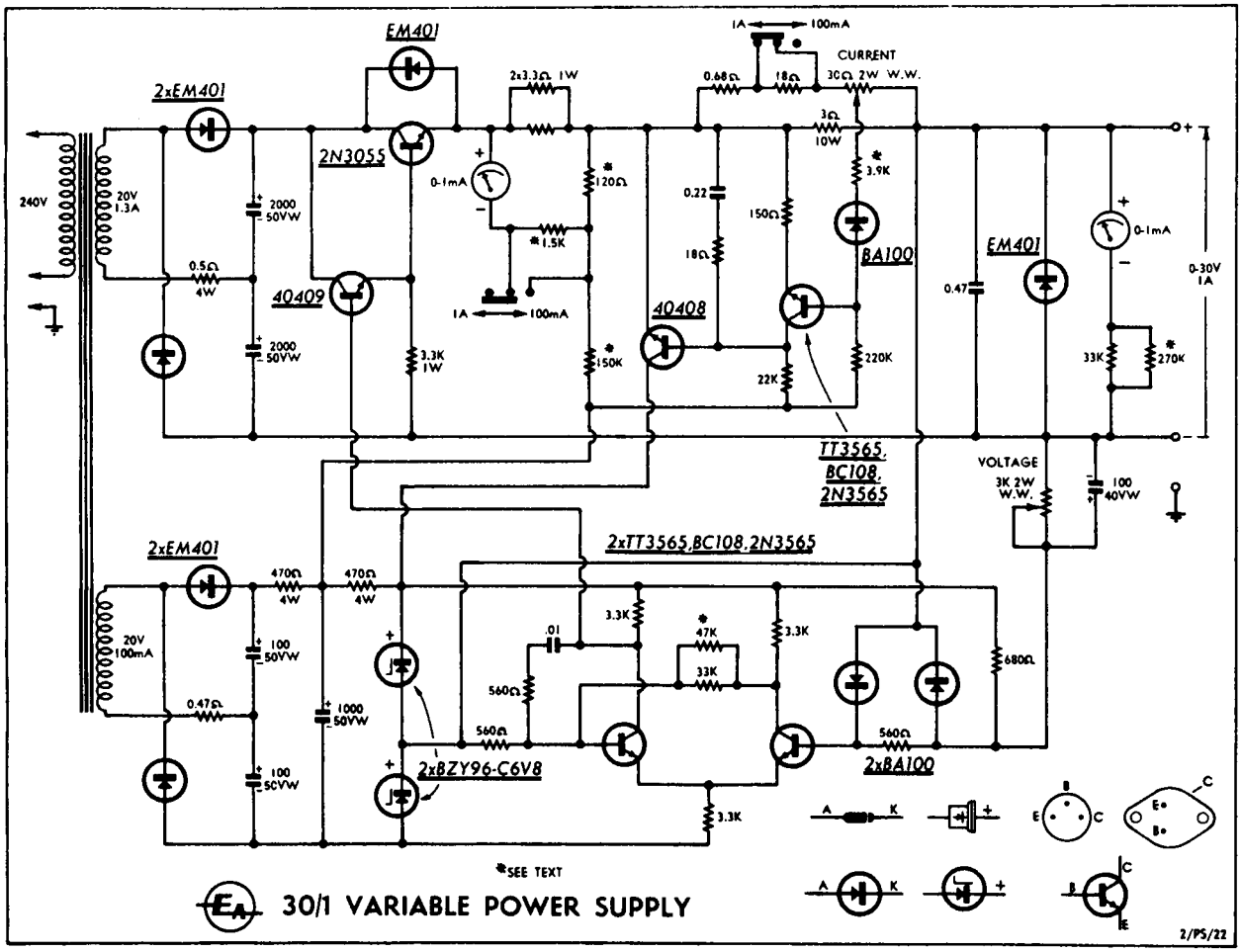


The circuit diagram of the new supply, which is shown above, may be divided roughly into two sections. The upper half shows the main supply and regulator together with protection circuitry, while the other is simply the reference supply and amplifier.

the reference voltage are C1 and C2. Since the current requirement of the reference circuitry is quite modest and the impedance levels are much higher relative to those at the output, the values of the capacitors can be quite small.

Having looked at the operation and circuit requirements in broad terms we can now, logically, describe the circuit in a little more detail. For convenience, the circuit diagram has not been drawn in the same form and order as the elementary schematic of figure 2; however, the transition from one to the other should be fairly straightforward.

The degree of regulation which can be achieved with the system is determined by several factors, including variations of ambient temperature. Logically, being the "heart" of the power supply, the reference voltage should be maintained as near constant as practicable, under all conditions.

The function of the reference voltage and differential error amplifier requires that their supply should be floating with respect to the output voltage and independent of the main supply. This has the added advantage of isolating the reference supply from the large voltage variations which are inevitable in the main power supply.

In deciding upon the transformer and rectifier configuration to be used, we had to firstly consider the requirements expected of the series regulator in the context of readily available power transistors. The device which appeared to be most suitable in this application is the RCA power transistor, type 2N3055, which costs only slightly more than three dollars, and as may be seen it is this device which we have used.

The 2N3055 has a power rating of a generous 115 watts at a case temperature of 25 degrees centigrade, with a maximum collector to emitter voltage rating BVceo of 60V. The transistor has a maximum collector current rating of 15A, with a minimum gain of 20 measured at 4A.

In practice the device should not be required to dissipate 115 watts as it would not normally be possible to maintain the case temperature at 25 degrees. Quite often the ambient temperature, in addition to the heat generated within the device, will bring its temperature to a level significantly above 25 degrees.

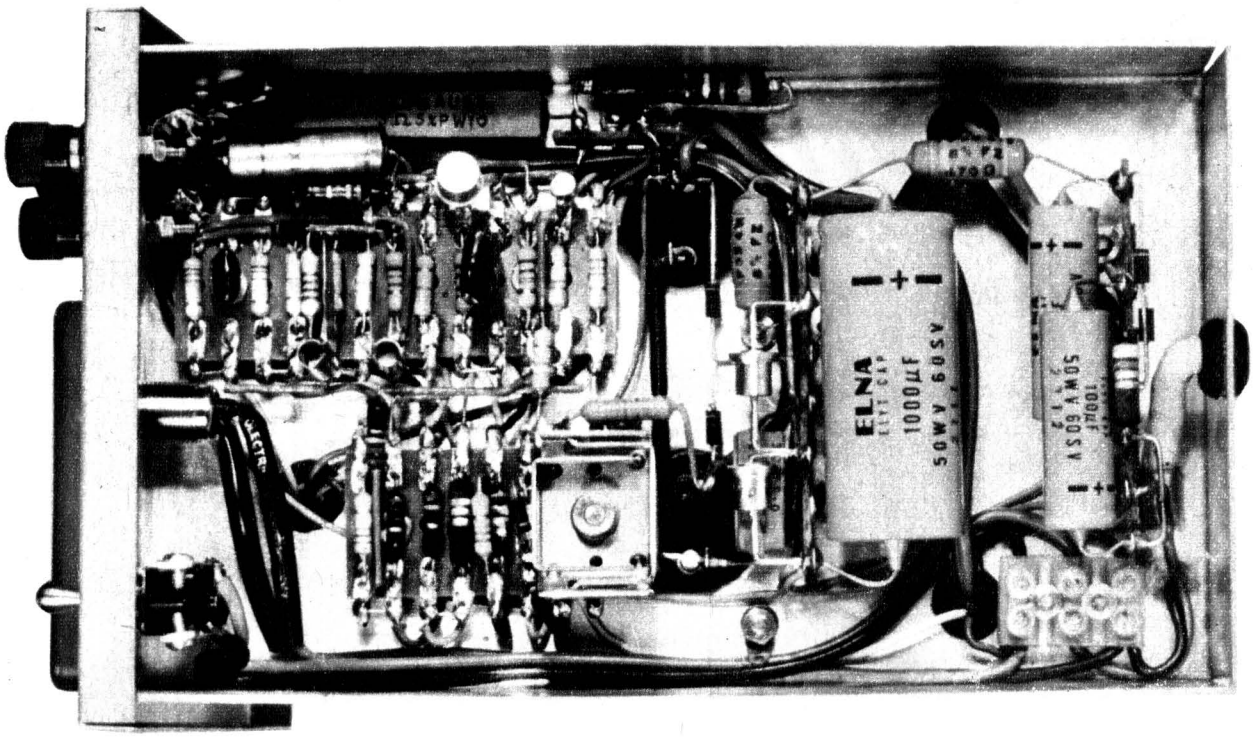
Maximum power will be dissipated in a series regulator transistor when it is required to deliver maximum current into a short circuit load, assuming the rectifier output voltage remains constant. Under these conditions, the transistor would ideally have almost the entire rectifier output voltage between collector and emitter. In practice though, the voltage from the rectifier will fall with increasing load, depending upon the transformer regulation and the size of the filter electrolytic capacitors.

For the present supply, the voltage from the filter should be no less than the maximum required output voltage of 30V, plus 5V to allow for IR drop across the current sensing resistors, and a further 1V representing the maximum saturation voltage of the transistor. Thus we must provide an absolute voltage of 36V.

There were not a great number of transformers from which to choose for the job, and none of these could be considered ideal in terms of voltage and current ratings; in addition there was the further requirement of a tertiary winding for the reference supply. After considering a number of units, we finally settled on a Ferguson transformer, type number PF2440, as being about the nearest to providing the design requirements at a modest cost.

This transformer as supplied has a centre-tapped secondary giving a nominal 19.4 volts per side, at 1.5 amps. Unfortunately the two windings comprising the secondary were internally connected in series, and were held firmly under the outside winding wrapper. Consequently, it was necessary to perform a slight modification in order to produce two separate windings.

After removing the centre-tap lead from beneath the wrapper, we slid off the plastic sleeving revealing a twisted pair of winding terminations. Then it was a fairly simple matter to separate the leads, provide them with individual sleeving and re-insert them under the outside winding wrapper for security. A similar procedure will have to be



Most of the major components in the supply will be easily recognised from the under chassis shot shown above. Of particular interest is the mounting of the 40409 Darlington driver transistor and the current sensing resistors.

followed by constructors, unless one or more of the transformer manufacturers is able to produce a unit with separate windings.

Clearly, with conventional full-wave rectification, the voltage from one secondary winding would not be sufficient for the regulator requirements. Hence, in order to provide sufficient voltage, we have employed a full-wave voltage doubler configuration which gives an unloaded DC output voltage of about 58V.

It should be fairly obvious that if this voltage were to remain constant under full load conditions, the series regulator transistor would be required to dissipate something like 53 watts under short circuit conditions. However, the voltage doubler fortunately exhibits sufficient lack of regulation to reduce greatly the maximum dissipation under short circuit conditions.

In fact the basic supply drops from an unloaded 58 volts to about 40 volts with a 1 amp load. This means that the series regulator will dissipate a little more than 35 watts under short circuit conditions, instead of something possibly much higher.

A second transistor is coupled to the series regulating power transistor, in a Darlington configuration, in order to increase the effective current gain. With a 2N3055 device having minimum gain, the drive power requirement of the second transistor will be about 1¾ watts, at the short circuit condition.

It was found necessary to reduce the impedance at the base of the 2N3055 by having a 3.3K shunt to the negative rail, in order to cancel the effect of collector to emitter leakage current. Consequently total dissipation in the driver transistor will be, at the worst, a little over 2 watts. Without the 3.3K shunt, the output voltage of the supply cannot be brought to zero, and the current metering circuit produces erroneous readings at low current levels.

List of Components

1 Case, 7½in x 5in x 8½in with chassis to suit.
1 Finned heat radiator, 6in x 4in.
1 Power transformer, 20V at 1.3A and 20V at 100mA.
2 Meters 0-1mA with scales 0-30V and 0-1A.
1 2-pole slider switch.
1 Mains toggle switch.
1 Pilot lamp.
3 Output terminals.

TRANSISTORS

1 2N3055, 1 x 40409, 1 x 40408, 3 x TT3565, BC108 etc.

DIODES

6 EM401, 3 x BA100, 2 x BZY96-C6V8.

CAPACITORS

2 2000uF 50 VW can mounting electrolytics.
1 1000uF 50VW eletrolytic.
2 100uF 50VW electrolytics.
1 100uF 40VW electrolytic.
1 0.47 uF low voltage plastic.
1 0.22uF low voltage plastic.
1 .01uF low voltage plastic.

RESISTORS ½-watt 5 per cent.

1 270K, 1 x 220 K, 1 x 150K, 1 x 47K, 2 x 33K, 1 x 22K, 3 x 3.3K, 1 x 3.3K 1W, 1 x 1.5K, 1 x 680 ohms, 3 x 560 ohms, 2 x 470 ohms 4W, 1 x 150 ohms, 1 x 120 ohms, 2 x 18 ohms, 2 x 3.3 ohms 1W, 1 x 3 ohms 10W, 1 x 0.68 ohms, 1 x 0.5 ohms 4W, 1 x 0.47 ohms. 1 x 3K 2W wire wound pot., 1 x 30 ohms 2W wire wound pot.

MISCELLANEOUS

4 Rubber feet, 2 small knobs, 1 carrying handle, 2 8-lug tag strips, 1 3-lug miniature tag strip, plastic terminal block and miniature resistor panel, mains cord cable clamp hook-up wire, nuts bolt and solder, etc.

We chose the 40409, another RCA silicon NPN device, for the Darlington driver, because it has a dissipation rating of 3 watts at 25 degrees centigrade ambient temperature; it also has very suitable voltage ratings. The 40409 is provided with a factory attached heat radiator, providing increased dissipation compared with the related type 40408, which would appear to be electrically similar, but having a dissipation of 1 watt.

The minimum rated gain of a 40409 is 50, measured at 150mA, making the minimum total gain of the Darlington pair 1,000. Hence, the largest current, which will have to be supplied to the 40409 base by the differential error amplifier, will be about 1mA.

The error sensing differential amplifier consists of two NPN silicon transistors (having lower voltage ratings) in a long-tailed pair arrangement. The amplifier has a regulated power supply consisting of another voltage doubler and two 6.8 volt 1.5 watt zener diodes.

The upper zener diode connected to the positive rail actually supplies the reference voltage Er. The second diode is provided to further improve the regulation by maintaining a constant negative supply for the differential amplifier.

A voltage doubler supply is used to achieve a high degree of hum filtering

of the reference voltage. In effect, the filter is comprised of two sections; one 470 ohm resistor and a 1000uF electrolytic in one section and a 470 ohm resistor and two zener diodes in the other. The total current required from the reference supply is a little less than 30mA.

In order to obtain a high degree of regulation, positive voltage feedback is applied to the differential amplifier, this being standard practice in commercial supplies. By adjustment of the feedback, the output impedance of the supply can be progressively reduced to zero — with further increases in the positive feedback giving rise to a negative output impedance.

In passing it may, perhaps, be noted that the effect of negative output impedance is that the output voltage will rise slightly as the load is increased. This situation should be avoided, not only because it again amounts to imperfect regulation, but more importantly, because it can lead to instability with certain types of load.

The amount of positive feedback applied to the differential pair will be determined by the ratio of the parallel 33K and 47K resistors, from the collector of one differential transistor to the base of the other, and the 560 ohm resistor from the second base to the zener diodes. The feedback may be adjusted by shunt 47K resistor across the 33K resistor, at the same time observing the change in output impedance, by monitoring the changes in output voltage with load.

In the absence of an accurate means of measuring voltage, such as a digital voltmeter or instrument of similar accuracy, the values specified for these resistors should be adhered to. If however, there is an observable increase in the loaded voltage, due to variation in component tolerances, the value of the 47K padding shunt should be increased until no observable increase is seen.

The stability of the differential amplifier, and hence to a large extent of the overall supply, is ensured by an R-C step circuit, connected from collector to base of that differential transistor which connects directly to the base of the Darlington series regulator. The step circuit consists of a 560 ohm resistor in series with a .01uF capacitor.

Two BA100 silicon diodes are included at the input to the differential amplifier as a means of protecting the base-emitter junction of the transistor concerned. Normally there is no voltage across these diodes and they do not conduct. However, sudden changes in the output voltage caused by shorting the output or by rapidly altering the output voltage control may produce transients which could otherwise destroy the transistor, were it not for the diodes.

The base of the same transistor is connected to a variable resistive divider, consisting of 680 ohms and a 3K potentiometer, which components correspond to R2 and R1 of figure 2, and hence determine the output voltage. The 100uF capacitor across the pot provides a large amount of ripple filtering for the supply, and corresponds to C2 in figure 2.

As stated earlier, the current cut-off amplifier is arranged to progressively shunt the reference voltage. In the early stages of development of this supply we focused our attention on various ways of providing current cut-off facility. These included the use of a tunnel diode between the base and emitter of a germanium transistor, to provide rapid switch-on, and also the use of a programmable unijunction transistor. However for various reasons these methods proved unsatisfactory and were subsequently abandoned.

The scheme which we have ultimately settled upon consists of two DC coupled transistors, providing a large amount of amplification and resulting in quite rapid turnoff. The system is arranged to cut off the first (normally conducting) transistor when the desired maximum output current is exceeded, thus avoiding the slow turn-on knee inherent in transistor and diode junctions.

With the high gain available in the cut-off amplifier, together with the particular phase relationships, an R-C step circuits is again necessary to secure AC stability. It consists of an 18 ohm resistor and 0.22uF capacitor in series, connected from base to emitter of the second transistor.

The bias for the first transistor of the cut-off amplifier has two components; one is the voltage developed across the 3 ohm sensing resistor, which is the reverse-bias component, while the other component is the forward bias supplied by the base voltage divider consisting of the 220K and 3.9K resistors. A forward biased silicon diode is included in the divider for temperature stabilisation of the cut-off threshold.

Current cutoff, which is made adjustable over two ranges, is controlled by the 30 ohm potentiometer across the sensing resistor. The maximum current at which cutoff will occur is set by the resistors in series with the pot, which are 0.68 ohms for the 1 amp maximum range and 18 ohms for the 100 milliamps maximum range.

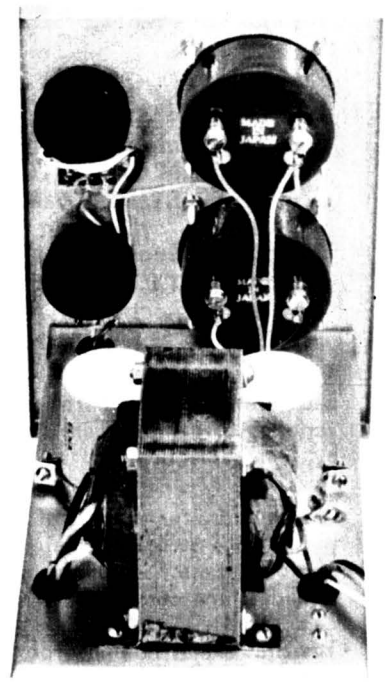
The minimum cutoff current of the supply as presented is 20mA, which is determined largely by the value of the 3.9K resistor in the cutoff amplifier bias divider. Some adjustment of the minimum cutoff level may be performed by variation of the value of this resistor; however, we would suggest that the minimum current be made no less than 20mA as the thermal drift effects could cause the amplifier to cut off the supply at zero load current.

The 3 ohm current sensing resistor for the cutoff circuitry is a 10watt unit; this was found necessary to prevent changes in the cutoff current as the resistor warmed up, as a result of its temperature coefficient of resistance. A second sensing resistor is used for the current metering circuit, consisting of two 3.3 ohm 1 watt resistors in parallel.

It was not possible to use the same sensing resistor for both cutoff and metering functions, without introducing both inaccuracies in current measurement and deterioration of the cutoff action. Even so, some current bucking is required to make the current meter read accurately down to zero output current.

A small bleed current of about 10 milliamps will always flow from the reference supply through the output-voltage divider resistors and the series regulator, producing a small voltage across the sensing resistors. The effect of this current is cancelled by supplying a small positive voltage at the junction of the 1.5K and 120 ohm meter-range multiplying resistors.

The values of the current range multiplier resistors were adjusted for the correct full-scale reading, first the 120 ohm resistor and then the 1.5K unit. Some adjustment of these values may be required to compensate for meter and resistor variations. With the values set, the bucking voltage is applied to make the meter read zero current in the absence of a load; in our case this required the use of a 150K dropping resistor. With the meter reading correct zero, it may be necessary then to readjust the 120 ohm resistor for a correct 100mA full scale reading.



At right is a view of the rear showing the placement of the transformer and electrolytic capacitors on the chassis. The layout of the components on the front panel is also clearly shown.

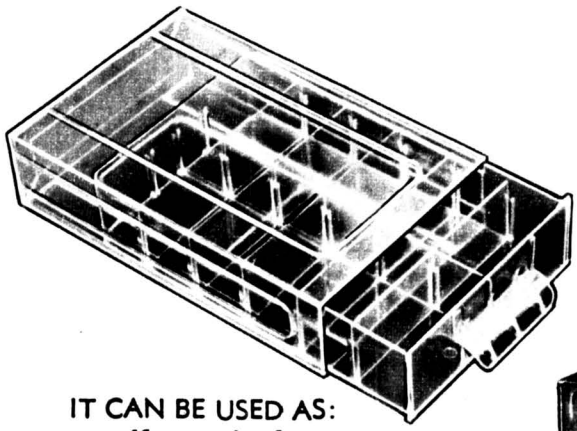
The voltmeter, with the series resistors shown, is connected directly across the supply output. The 270K padding resistor may have to be altered to suit individual meters. The meters, which we used are 3in rectangular 0-1mA units and are provided with appropriate voltage and current scales. They are of Japanese manufacture, being coded type VP-2A.

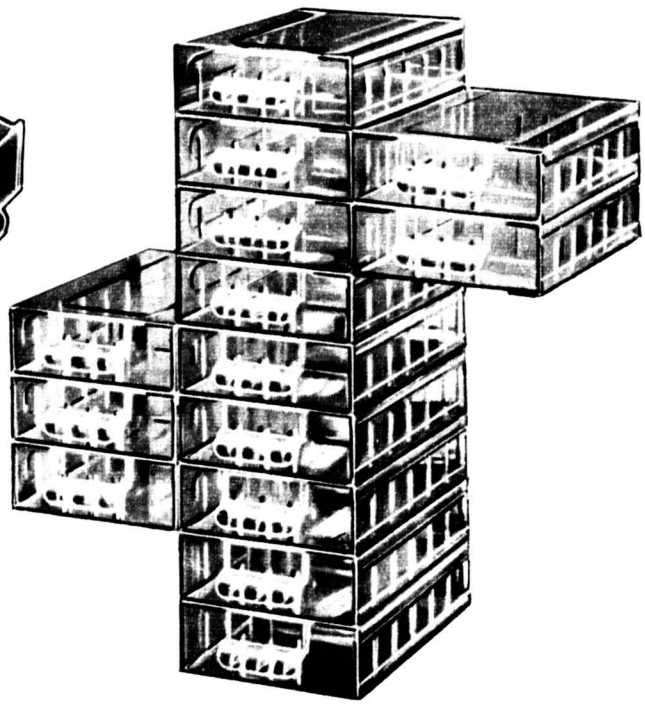
An extra measure of protection for the power supply is provided in the form of two power diodes; one connected across the output so that normally it does not conduct, the other connected between collector and emitter of the 2N3055 power transistor, so that it also does not normally conduct. Both diodes provide protection against negative input voltages to the supply, which voltages might be applied if two supplies were

(Continued on page 174)

MULTIDRAWER

A TRANSPARENT MULTI-COMPARTMENT DRAWER AND OUTER CASE MADE OF STRONG CLEAR PLASTIC





IT CAN BE USED AS:

- **a self contained STORAGE BOX UNIT**
- **or a MULTIDRAWER CABINET by joining the individual units**

IMMEDIATE ASSEMBLY by sliding action

NO GLUE — NO TOOLS NECESSARY!

Each drawer can be partitioned into 12 varieties of compartment arrangements by removable dividers.

The Multidrawer consists of a drawer sliding into an outer case. Both parts are made of strong clear plastic to ensure immediate visual location of stored articles (opaque outer case also available).
The outer case has built-in integral dovetails and grooves for vertical and horizontal assembly by means of sliding the corresponding sides. This assembly is achieved instantaneously without using any tools or cement.
The drawer has built-in grooved side ribs, which allow its partitioning into 13 possible combinations of compartments by simply dropping into the grooves standard dividers, available in 4 lengths. The longest of the dividers is provided with the same ribs as the drawer in corresponding positions, to firmly hold the smaller dividers.
The dividers can be left as removable for any future rearrangement, or could be cemented in by using TRICHLORETHYLENE.
The assembled cabinet will firmly stand on any flat surface and will not require additional reinforcement.

AT HOME: as a box for sewing, jewellery, haberdashery, hair accessories, cosmetics, medicaments, fishing accessories, writing utensils, small hardware, cigarettes and cigars, photographs, colour slides and many others,
AND IN: SHOPS, OFFICES, WORKSHOPS, LABORATORIES, STORES and FACTORIES.
for visible storage of small parts and also as production assembly aid.

THE MULTIDRAWER — THE STORAGE BOX OF 101 USES

SPECIFICATIONS: Drawer — transparent. Outer case — opaque (steel grey). Dimensions—Identical for both models are: Outer Case: Length: 9 5/16", width: 6 7/16", Height: 2 3/8". Drawer: Length, 9 3/8", Width: 6", Depth: 2". Protrusions of the handle — ¾". Weight of the unit — 12 ozs.

Also available from General Accessories interstate Branches. **Trade Enquiries Invited**

Write to General Accessories for further information and Price List.

GENERAL ACCESSORIES

(A DIVISION OF ELECTRONICS INDUSTRIES)

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RADIO FOR BALLOON THAT NEVER FLEW

When balloon "Nancy" developed a leak and collapsed in an untidy heap on Pearce RAAF airbase, the staff of "Electronics Australia" shared the disappointment of the crew and sponsors. For several weeks beforehand, we had been intimately involved in sorting out problems of communication from what we hoped would be a record-breaking balloon, to aircraft controllers, to land parties, to photographic aircraft and to the Flying Doctor Service.

By Neville Williams

During the preparatory period, the plans and preparations for the flight were covered by the regular news media—newspapers and weekly magazines, radio and television stations.

There were many facets to the story: The balloon itself, which had to be manufactured in England; the frustrating hold-up while it sat at London airport waiting settlement of an airline dispute; construction of the huge basket by blind weavers in Sydney; the hundred and one details essential to sustain the crew for an anticipated six-day period in "space"; the job of getting equipment, trucks and thousands of cubic feet of hydrogen gas from the east coast to Pearce in Western Australia.

And, of course, the part in which we were involved: Planning communications on a scale that would meet the requirements of air navigation authorities and the news media sponsoring the venture, without going beyond what was practical in a free-flying, hydrogen-filled balloon.

All this, based on information which, for the most part, had to be picked up second- and third-hand from a few balloon enthusiasts 12,000 miles away.

But, if the art of ballooning was new to the crew and to those concerned with providing back-up facilities, it was also new to Australia's Department of Civil Aviation—DCA, for short. The department has any number of regulations covering the design, maintenance and operation of conventional powered aircraft but the regulations were never designed to include manned, free-flying balloons.

On many aspects of the project, from the nature of the vehicle itself to facilities such as navigation equipment and warning lights, department officials had to find answers which paid due respect to their own strict safety regulations but which were still practical in terms of ballooning. The fact that the crew were qualified Mirage pilots, with the informal blessing of the R.A.A.F., was at least a help in "adapting" to the venture what are normally rather inflexible regulations.

Well to the fore was the problem of ensuring adequate radio communication, so that air controllers would have reliable contact with the balloon, despite the distances involved, atmospheric static and high frequency skip.

As far as air space was concerned, the balloon would be a manned, airborne vehicle, and one of considerable size and weight. Air traffic controllers would need to know at all times its position, height, course and speed. They would have to be able to order a change in altitude or even termination of the flight if a dangerous situation should threaten. And, in the event of a forced landing in a remote area, the department would have to be able to initiate effective search and rescue procedures.

For powered aircraft, type-approved radio equipment and recognised operating procedures are available to meet such requirements. The various control centres have their own recognised channels, with alternative frequencies designed to cope with the vagaries of high frequency radio transmissions. And, with storage batteries and generators powered from the motors, power to operate the necessary airborne equipment is not a particular problem.

But a balloon is an airborne vehicle of a very different kind. It has no motors and, in fact, there is very good reason why it mustn't have any, in an environment that might contain more than its share of free hydrogen! Power for radio equipment can only come from batteries — at the present time anyway—and a lot of storage capacity would be needed to maintain a continuous listening watch and full transmit capability for a flight which might last from five to eight days.

The possibility of equipment failure also had to be faced. Since a loss of communication with the D.C.A. network would mean automatic termination of the flight, there could be no alternative but to equip the balloon with two separate transceivers, either one being able to maintain essential communication on its own.

The unit finally selected for basic communication was the A.W.A. Teleradio type 60A. Completely self-contained, apart from the hand microphone, it measures 12 x 6 x 12 inches and weighs 17lb. It has provision to operate on any of five crystal-controlled frequencies between 2 and 10MHz, at the turn of a switch.

It is transistorised, apart from the transmitter output section, and can be used to maintain a constant listening watch for a current drain of about 70mA from the 12V supply. A separate switch function allows the valve heaters to be readied for transmission, the ultimate transmit current being about 8A.

After considerable discussion with D.C.A. officers, it became apparent that D.C.A. requirements would be met if the transcievers were equipped to operate on the general D.C.A. frequency of 8939MHz, in addition to one frequency each for Perth and Sydney control. The balloon would have to maintain a continuous listening watch on the channels appropriate for the area and the time of day, and report its position on schedule every four hours.

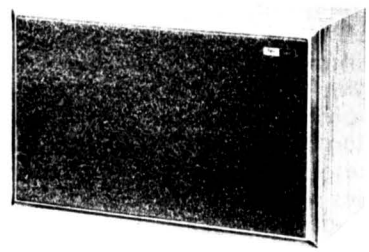
These arrangements left two channels free on each of the transceivers and made it possible to include crystals for the Flying Doctor network on 2020MHz plus an individual "private"

Because of its topicality, this story was substituted for the Forum pages just before the issue went to press. Forum will appear in the next issue, as usual.

Sounds Best
by Goodmans

Ten-Ten

A loudspeaker system for discerning listeners who demand quality without frills. At a reasonable cost, the TEN-TEN is the answer for "budget" audio installation. Ideal for use with tape recorders. This twin-speaker system has an impedance of 4 ohms, which makes it suitable for use with a very wide range of equipment. Power Handling: 10 watts (20 watts U.S.A.) Range: 60–20,000 Hz ± 6db. Dimensions: 14½" x 7¼" x 9½". (36·8 x 18·4 x 24·1 cm.)



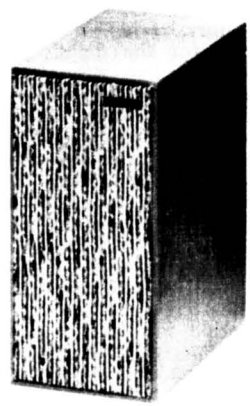
... and from Goodmans world-famous "M" Range of High Fidelity Loudspeaker Systems

Maxim

The first and still the best! A true High Fidelity Loudspeaker system complete, the size of a shoe-box – 10½" x 5½" x 7¼". The meticulously finished cabinet in hand-rubbed teak (or walnut) houses two tiny precision direct radiator drive units which cover the frequency range – 45-20,000Hz – with less deviation from level response than almost any other High Fidelity Loudspeaker – and handle 12 watts of power easily. No problems in finding room for it – just move a couple of books.

Specification

Dimensions	10½" x 5½" x 7¼" deep (26·7 x 14 x 18·4 cm.)
Range	45–20,000 Hz
Power	12 watts
Impedance	15–16 ohms

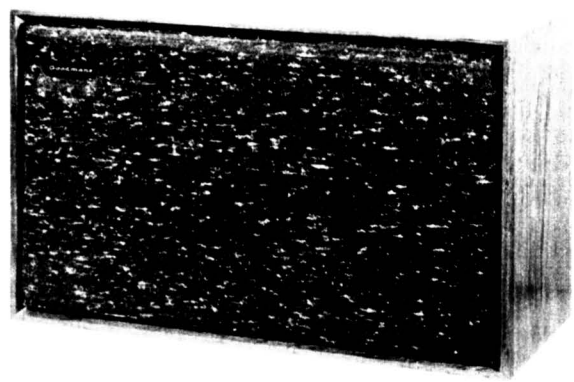


Mezzo II

Handles 15 watts of power – yet measures only 12" x 19½" x 9" deep – the MEZZO really will go on a bookshelf. The styling is restrained yet distinctive, making MEZZO an "easy" addition to any design-conscious furnishing scheme. The frequency range is a clear and clean 40-20,000 Hz with a control and smoothness accounted for by two new specially developed and patented loudspeakers. The 12" bass unit is of very advanced design and construction, and is particularly notable for its very low distortion and extraordinary smoothness of performance. It is claimed to be the smoothest bass reproducer of its size ever produced. The treble unit, with attenuator control, completes the quality picture to give an overall performance unrivalled in a reproducer of this size. The L.C. crossover network operates at 2,000 Hz. The distortion level is extraordinarily low. The perfectly controlled balance of the MEZZO sound makes it – The Loudspeaker to Live With.

Specification

Dimensions	12" x 19½" x 9" deep (30·5 x 49·5 x 22·9 cm.)
Range	40–20,000 Hz
Power	15 watts
Impedance	8 ohms



Agents in Australia: **British Merchandising Pty. Ltd.**
P.O. Box 3456, G.P.O., Sydney, N.S.W.
Shaw House, 49-51 York Street, Sydney, N.S.W. Tel: 29-1571/3

channel on each transceiver for communication with the ground parties on each of two trucks. The "private" channels were two frequencies normally allocated to the R.A.A.F. but made available to the balloonists for the occasion.

Having decided on the transceiver equipment, it was necessary to estimate and also set a limit on the amount of traffic it would have to handle, particularly in the battery-hungry stand-by or transmit modes. By adhering to strict schedules and procedures for both D.C.A. and ground crew traffic, it seemed likely that one 30AH battery would power each set for a five or six-day flight. Four such batteries would provide a safety factor of two. Ultimately, six batteries were loaded aboard to cover the possiblity of the flight lasting longer than this.

Consideration had to be given to the effect of reduced temperature at the higher altitudes on battery operation. Examination of relevant tables indicated, fortunately, that there would be no likelihood of the electrolyte freezing or of battery capacity being seriously reduced at the temperatures which the crew themselves could tolerate.

Additionally, the crew undertook to include in its checking procedures one to ensure that the transceivers would not inadvertently be left in the "Stand-by" position after a transmission, with the transmitting valve heaters draining the batteries to no purpose.

Having reched such decisions for the balloon itself, it seemed logical to use the same 60A Teleradios for the two trucks. These were duly provided with crystals for each of the R.A.A.F. frequencies for "private" traffic, the flying doctor frequency, and the DCA general frequency of 8939MHz. In the case of the trucks, installation and power posed no problems. The units were slung beneath the dash in standard mounting cradles and powered from the truck's electrical system.

Aerials for the four transceivers posed their own problems. Original intention was simply to fit the trucks with a long, untuned whip, with the idea that it could be supplemented, where necessary, by a long wire thrown over a handy tree.

Inquiries established, however, that while the 60A Teleradios had provision for loading into aerials of random length, the overall efficiency in this condition would be far below what it can be with a whip optimised for the transmission frequency.

Provision was therefore made to equip each of the trucks with a Belling and Lee resonant whip aerial, optimised for the frequencies to be used by the trucks. Designated as type HFW1-6, the aerials take the form of flexible, tapered, fibreglass rods carrying a helical-wound copper-wire radiating element. The radiating element is protected by an outer sleeve and a surface finish, the required resonance characteristic being achieved by cutting to a critical length and adding a top loading section.

With four widely separated operating frequencies, four whips were required for each truck, each to be screwed as required into an insulated, sprung mounting base. To avoid confusion, the whips were colour-coded to correspond with the appropriate bandswitch positions on the associated transceiver.

A view inside the basket. Flying-Officer David Robson, commander of the expedition, is seated at left at the instrument and radio panel. Flight-Lieutenant John Ellis, top, and seated on the bed, is operating the radio; at his shoulder is the battery switching facility. Flight-Lieutenant Jack Hayden, in the foreground, is at the the navigator's table. Stores are under the lift-up seats and bed, while sandbags and batteries are slung overside, the latter in stout metal boxes.

For the balloon, any kind of rigid aerial would have posed difficulties, whether permanently mounted or intended for setting up in flight. A trailing aerial seemed a more logical choice, since it could be let down in flight and could be of any desired length.

But there was also an objection to just any length of aerial relative to the operating frequency, in that it could produce a high RF voltage at the feed point, with the attendant danger of an arc. The Department of Civil Aviation insisted that high RF voltages must be avoided within the immediate vicinity of the basket and balloon and, further, that means must be provided to wind in any trailing aerial rapidly, if the balloon were drifting close to ground level.

To meet these requirements, two hand winches had to be contrived, mounted one either side of the basket, to that the weighted aerials would hang as far apart as possible. The aerials were fed out through metal ferrules which also provided the necessary RF feed connection. Colour bands along the wire indicated the length of wire to reel out for low impedance feed and good radiation efficiency on the various allotted frequencies.

Over and above the teleradio system, intended to handle official and private messages, D.C.A. required that the balloonists carry a self-contained survival radio beacon to attract guide rescuers' in the case of a crash landing. A suitable Sarbe beacon, type BE355, was made available to the crew by D. R. Johnston and Co. Pty. Ltd., of Melbourne.

As interest in the project grew, it was foreseen that reporters and photographers covering the flight for newspapers, TV and radio might want to hire planes along the route, for close-up aerial shots. Since it might not be possible — or advisable — to use any of the Teleradio channels for balloon-to-plane communication, some other means had to be found. So along went some ordinary 1-watt handie-talkies operating in the commercial band. By having one available in the balloon, along with a supply of dry cells, and another available to reporters using the planes, communication would be possible without using the main Teleradio communication system.

The need for one other item of equipment also became evident — tape recorders which would allow the balloonists to record first person impressions of the flight for later use; also for use by reporters to record their impressions and to record the necessarily brief exchanges during scheduled transmissions.

Philips type EL3302 cassette recorders therefore took their place in expedition Westwind, along with yet another stock of cells and a handful of 120-minute cassettes.

For crew and sponsors alike, it was a cruel twist of fate that all the planning and all the work should be defeated by a leak in the envelope which earlier tests had not revealed. ■

poly-planar

ULTRA-THIN, WAFER-TYPE, WIDE-RANGE, ELECTRO-DYNAMIC SPEAKERS

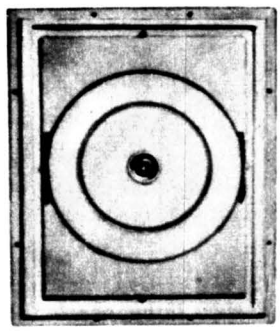
Replace Cone Speakers in Any Application.

The Poly-Planar speakers employ a lightweight acoustic panel supported by a frame of compatible plastic material to reproduce a wide range of frequencies. There is also a minimum of piston motion resulting in low distortion and high electromagnetic efficiency. The unique construction of these electromagnetic loudspeakers provides a combination of characteristics not available from conventional cone speakers or equivalent designs.

ADVANTAGES OF THE POLY-PLANAR

- **Wafer-thin construction permits new design and installation ideas.**
- **Wide-range performance—low distortion.**
- **Rugged—meets extremes of shock and vibration.**
- **Wide temperature operating range: —20° to +170°F.**
- **Completely waterproof—more than just moisture-proof.**
- **Easily incorporated into present equipment.**
- **Priced competitively with conventional loudspeakers.**
- **Bi-directional polar pattern**
- **High-power capability.**
- **Lightweight.**
- **Ideal for consumer, industrial or military applications.**
- **Completely replaces the conventional cone speaker.**

20 WATT MODEL

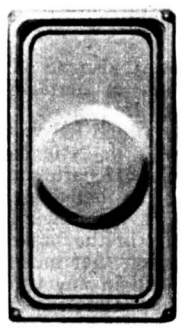


SPECIFICATIONS

Model designation:
P-20 Poly-Planar
Power capability:
20 watts peak
Frequency range:
40 cps—20 KC/S

Sensitivity: 85 DB/M
for 1 watt electrical input
Input impedance: 8 ohms
Size (WxDxL): 1-7/16″
x 11-3/4″ x 14-11/16″
Weight: 19 ounces

5 WATT MODEL



SPECIFICATIONS

Model designation:
P-5 Poly-Planar
Power capability:
5 watts peak
Frequency range:
60 cps—20 KC/S

Sensitivity: 80 DB/M
for 1 watt electrical input
Input impedance: 8 ohms
Size (WxDxL): 13/16″
x 4-1/2″ x 8-1/2″
Weight: 10 ounces

Trade enquiries: **GOLDRING ENGINEERING (A/ASIA) PTY. LTD.**
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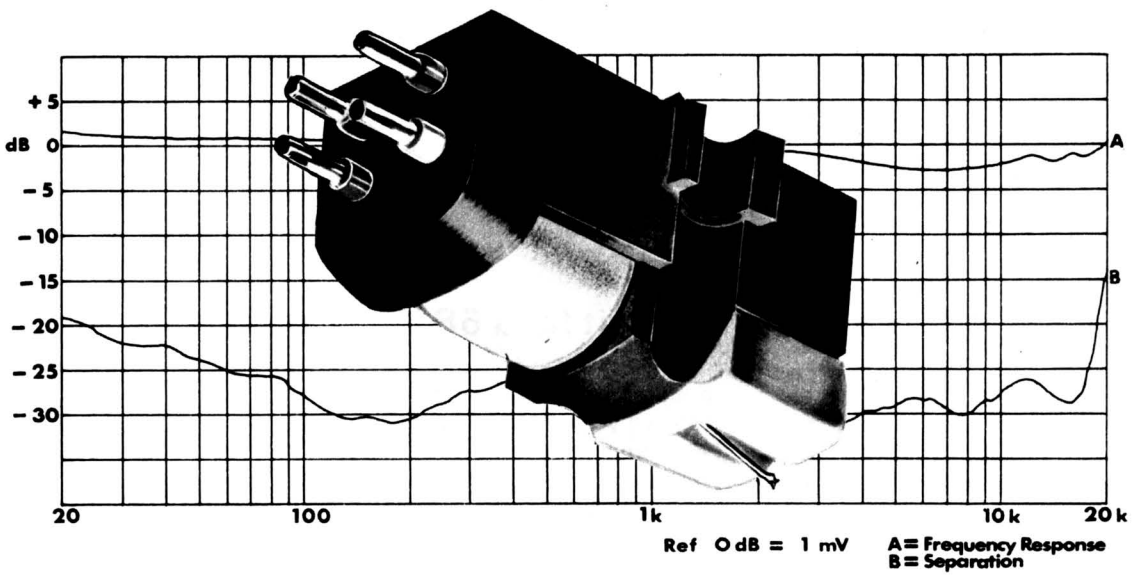
Chosen by the BBC... GOLDRING '800' SERIES



Goldring '800' and '800E' free field stereo cartridges

With a choice of the finest cartridges anywhere in the world, BBC engineers chose the Goldring '800' series. They recognised the unparalleled advantages of the 'free field' system in re-creating the finer shades of original sound. Read the specifications and you'll agree. In these cartridges a very lightweight tube of magnetic material lies in a 'free field' generated by a fixed source coupled to a low mass diamond point. They feature low mechanical impedance, tracking at 1 to 3 grams (800) and 0.75 to 2 grams (800E), screening from external hum fields, gold-plated contacts. Stylus is replaceable.

Specifications:	**'800'**	**'800E'**
Type	Magnetic	stereo & mono
Frequency Response	20Hz-20kHz	10Hz-25kHz
Sensitivity	5.5 mV at 5 cm/sec	
Separation	25dB at 1kHz and nowhere less than 15 dB	
Load	100k-47k/ohms	
Compliance	20×10^{-6} cm/dyne	30×10^{-6} cm/dyne
Static Effective Point Mass	1 mg	less than 1 mg
Stylus Point	Conical 0.0005" diamond	Elliptical .0008" x 0.0003" diamond
Tracking Weight	1-3 gm	0.75-2 gm
Head Weight	8 gm	
Connections	4 pins	
Fixing	Standard ½" centres	
Vertical Tracking Angle	15°	
Mu-Metal Shield for hum protection		
Removable Stylus		

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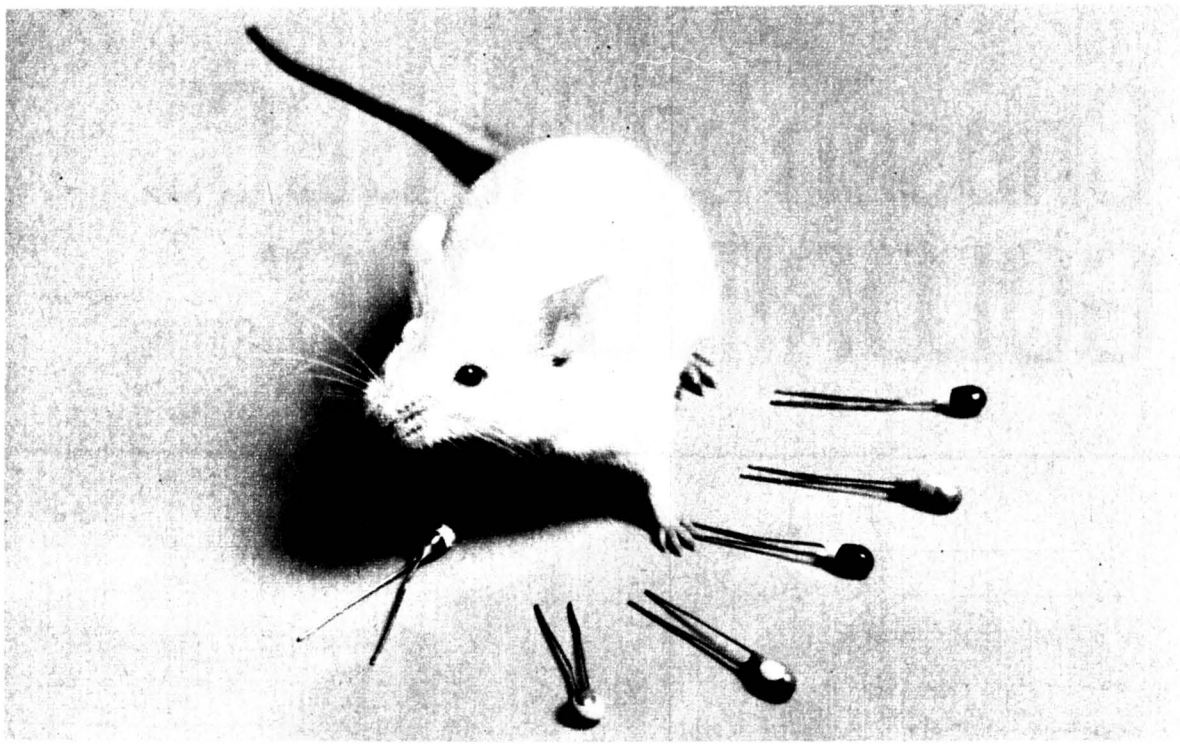

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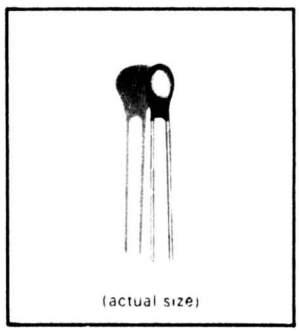

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THE PLAYMASTER 122 PROGRAM SOURCE

Alternative components and circuit configurations

Last month, we presented the program source in an "all stops out" version. It is the aim of this article to suggest a number of alternative approaches to certain parts of the circuit. These variations may be necessary or desirable, according to the nature of the item or individual requirements.

By Ian Pogson

Perhaps the greatest scope for variations exists in the power supply and we will discuss this section first.

You will have noticed by now, that we used a half-wave voltage doubler circuit, suitable for use with a 6.3 volt AC supply. This was done for two main reasons. A 6.3 volt source is often available in one form or another and more than likely, it will be unbalanced —in other words, one side will be earthed.

If you have 6.3 volts AC available from the existing amplifier setup, you can run a pair of leads from the amplifier and connect them into the appropriate points on the tuner printed board. This obviates the need for a separate transformer, as shown on the unit described last month.

If a floating 6.3 volt supply happens to be available, so much the better. We have made provision on the printed board, by the use of different links, to provide for either half-wave or full-wave voltage doubling and rectification. Theoretically, at least, the full-wave system is superior from a hum point of view and we suggest its use where possible. This does not mean, however, that problems will be experienced with the half-wave system.

To make the best use of the floating 6.3 volt supply, simply connect it to the board of the tuner and insert the links as shown on the photograph for full-wave operation.

Although we used a transformer in the original tuner and connected it as a half-wave voltage doubler, there is no reason why it should not be changed to the full-wave arrangement, provided it suits you to do so.

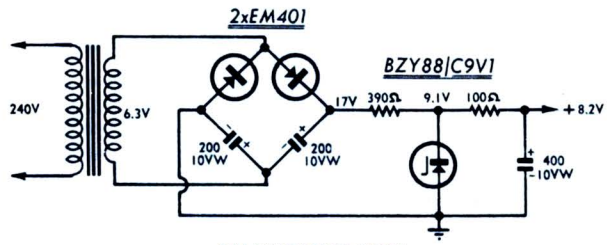
The operation of the full-wave voltage doubler is such that half the DC output voltage appears across each of the two voltage doubling electrolytics and the working voltage can be rated accordingly. It is important to note that when using the half-wave voltage doubler, that the second of the two doubling electrolytics has the full DC output voltage impressed upon it. This calls for a first electrolytic rated to work at half the DC output voltage, while the second electrolytic must be rated for the full output voltage.

It is appropriate at this point to consider the choice of a 6.3-volt transformer to suit the particular need. We took a good look at this problem which at first sight, may not appear as a problem at all.

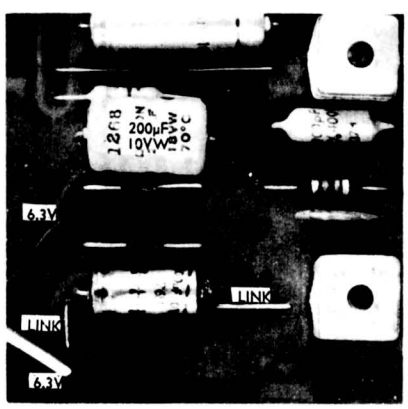
As the supply requirement for the tuner is a few milliamps only, plus the bleed current through the zener diode, the total current amounts to something like 20 milliamps in all. It follows that only a very small transformer is needed to meet this demand. Most of the suitable transformers which are readily available, are heater transformers for valve use, with a rating of the order of one amp.

While these transformers do the job, for which they were designed, in a satisfactory manner, their regulation is anything but good. Used under a very light load, the output voltage may be considerably higher than the intended 6.3V, which leads to a higher voltage than expected in the voltage doubling circuit in particular.

The full-wave circuit is straight-forward, the 17V quoted being an approximation.



FULL WAVE POWER SUPPLY



The points to note on the full-wave power supply, are the positions of the links and the 6.3 volt AC input points. The 200uF 18VW electrolytic, used for half-wave, is now 200uF 10VW.

As mentioned previously, with half-wave doubling, the component which is called upon to bear the brunt of the higher voltage situation is the second electrolytic, which has the full doubled voltage across it.

According to the lists, 200uF electrolytics are available in voltage ratings of 10, 12 and 18. Either the 10V or 12V unit would be suitable for the first position and, since the voltage across the second electrolytic should only reach about 17.5 volts, the 18V unit would be satisfactory for this position. In fact, we found the voltage to rise considerably above 17.5 in some circumstances. The catch is that the next readily available voltage rating above 18V is 50V. This is a large and more costly component and should be avoided if possible.

We made appropriate measurements with some of the transformers in position, which readers are likely to use, and our findings should be useful as a guide.

In the original tuner we used a Ferguson type PF1728. It has two 6.3 volt windings and these can be used, one for the power supply and the other for the dial lamp. Alternatively, both power supply and lamp may be paralleled across one winding, leaving the other unused. It makes no difference which combination is used, each arrangement giving 17.5 volts across the second electrolytic. Without a pilot lamp, the voltage rises well above 18 volts and the higher voltage rated electrolytic would be needed.

Another popular transformer is the Ferguson PF2315, having one secondary winding labelled 6.3 volts at 1.0 amp. It is smaller than the PF1728 and appears to be an attractive proposition for the tuner. However, we found that without any pilot lamp, the voltage was too high for the 18V electrolytic. Even with a pilot lamp, although the voltage was lower, it was still too high for the 18V capacitor. With two pilot lamps, the voltage was in order at 17.5V. As this tuner only uses one lamp, special care will be needed if you use this transformer. A later version of the tuner may use two pilot lamps.

Another transformer is the A and R type 5579, which is somewhat unusual in its ratings, making it rather a versatile unit. It has one 6.3V winding and three taps are available for current ratings of 300 milliamps, 600

milliamps and 1 amp. Connected to the 300 milliamp tap and with no pilot lamp, 17 volts appeared across the electrolytic. Adding a pilot lamp dropped the voltage to 16.5V. From the 600 milliamp tap and with two pilot lamps, the voltage measured 16.5V. Finally from the one amp tap and with two pilot lamps, we obtained 18.5 volts. This transformer is thus suitable for the present tuner, when the 300 milliamp tap is used.

A very small transformer rated at 12.6 volts centre tapped, at 150 milliamps, is the Ferguson PF2851. By using one half of the winding and without a pilot lamp, we measured 17.5 volts. This is satisfactory, but it rules out the use of an ordinary pilot lamp. However, it is possible to get lower current ratings in 6V lamps and one of these should be satisfactory, even though it would, no doubt, result in a somewhat lower voltage across the electrolytic.

Before moving on to other points, it may be worthwhile to point out that the voltage at the output of the doubler is not at all critical, provided that the electrolytic voltage rating is not exceeded. The available voltage will usually be more than adequate and any surplus can be dropped across the 390 ohm resistor.

When full-wave voltage doubling is used, as only half the total doubled voltage appears across each of the 200uF electrolytics, it follows that either the 10V or 12V ratings would be in order.

Another point arises when using the full-wave system and where only one 6.3 volt transformer winding is available. Since the pilot lamp feed must be connected in parallel with that to the voltage doubler circuit, care must be taken to avoid an accidental short circuit from either side of the 6.3 volt winding to earth. McMurdo and possibly others make a suitable line of insulated lamp holders.

The possibility of using alternative types of rectifier diodes may also be considered. Any equivalent to the EM401, even with lower inverse voltage ratings would be satisfactory. The idea of using small silicon and germanium diodes, such as the BA100 or the OA91 was considered and indeed, a pair of BA100s survived the full testing period and are still operative. These types, however, are not recommended on the grounds that, while they will pass the load current and withstand the inverse voltage, the switch-on surge current may cause failure.

If you really wish to use the low power diodes, insert a surge protecting resistor in series with one leg of the 6.3 volt supply from the transformer; a value of 27 ohms should be satisfactory.

The next point for investigation, is the possibility of a substitute for the CF-455-CP wide-band ceramic filter. The price of these filters, although commensurate with their performance, may be a deterrent for some. It is worth noting that these filters do offer very steep skirts, and an order of nearby channel rejection which is not easy to secure by more modest means.

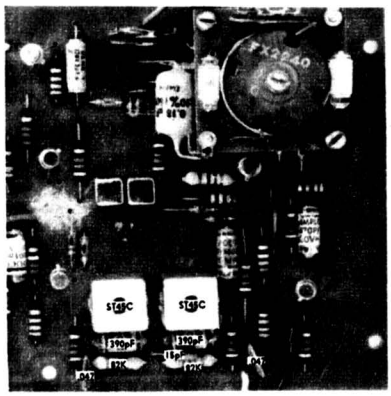
The very simplest substitution for the ceramic filter, is to replace it with a 470pF polystyrene capacitor, which is simply strung across the position

which would otherwise be occupied by the top input and output terminals of the filter.

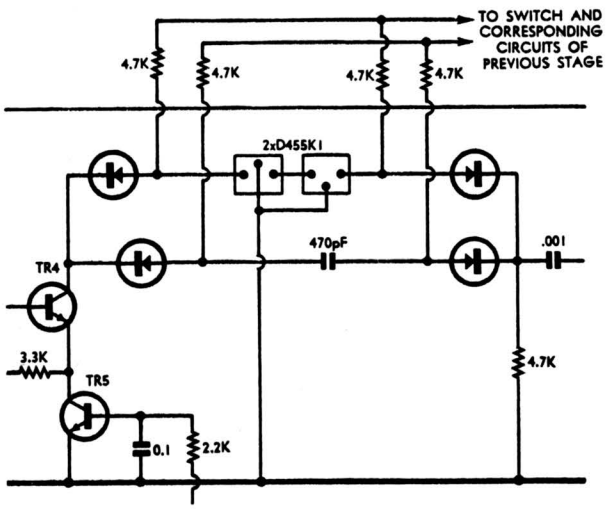
Not surprisingly, such a cheap substitute for an expensive item will result in a rather cheap performance, although the bandwidth and frequency response for the wanted signal will not suffer at all. There will, however, be a substantial loss of sensitivity; this may or many not matter since as the broad position of the tuner is normally used only for strong local signals. The main effect that the substitution will have on the performance, is a drastic loss of skirt selectivity in the broad position, with a consequent risk of nearby channel interference.

The sharp selectivity performance is not affected in any way, of course.

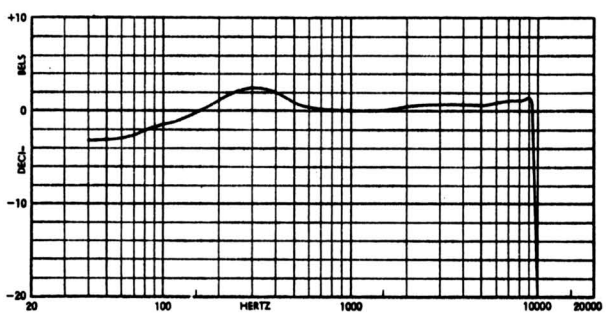
As you will have gathered, we do not recommend this approach. However, if you do try it and the results are not satisfactory, you can always adopt one of the preferred methods.



This picture of the second pair of IF transformers shows the items required to replace the wide-band ceramic filter.



This circuit shows how the ceramic wide-band filter may be replaced with a 470pF capacitor. It could be tried before fitting more expensive items.



An audio response curve, taken in the wide position and at 600KHz. It is very similar to the previous curves with the ceramic filter.

A method which should be satisfactory for most conditions, is to use a pair of ST45C IF transformers back-to-back, similar to the pair already used after the mixer-oscillator. The printed wiring board is arranged so that this method may be used if desired. Apart from the omission of the ceramic filter from the assembly, the two links which are required with the ceramic filter, are also omitted. In the places provided, are mounted two ST45C IF transformers, two 390pF capacitors, two .047uF capacitors, one 15pF capacitor and two 82K resistors. It is as simple as that. This is all detailed on the coded photograph and the circuit diagram.

There appears to be little difference in sensitivity when this filter is used, when compared with the ceramic filter. However, as may be expected, we rarely get something for nothing. The skirt selectivity, although adequate for most locations, is not as good as that obtained from the ceramic filter. We took an audio frequency response curve with the tuner thus modified and as you will see, it compares favourably with the one published last month.

Adding these extra IF transformers does not make alignment any less easy than with the previous arrangement. All it means is an extra couple of operations to the procedure.

Referring to the alignment details as outlined last month on pages 69 and 71, proceed as before and up to the point where you have aligned the band-pass tuner circuits. From here on, the same procedure is still followed, except that instead of aligning the pair of back-to-back IF transformers after the mixer-oscillator, use the same techni-

que first on the second pair. When you are satisfied that they are right, then proceed with the first pair. In point of fact, it can be done quicker than it has taken to write about it.

Another point worthy of mention is the possibility of using other types of transistors. Our investigations so far indicate that the first six transistor positions, from TR1 through to TR6 are not particularly critical and a number of near equivalents to the BF115 may possibly be substituted without any change in circuit component values. We have, in fact, subsituted STC type TT331 in positions TR1 to TR6 with no problems at all.

Similar substitution for TR7 and TR9 did not work out as well. These two stages are directly concerned with the AGC system and it appears that the TT331 transistors generate too much control, with a consequent serious drop in audio output from the unit. This could probably be corrected simply by replacing the .001uF capacitor from TR6 to TR7 with a lower value, such that the audio output is restored. It would have to be determined experimentally to meet individual requirements.

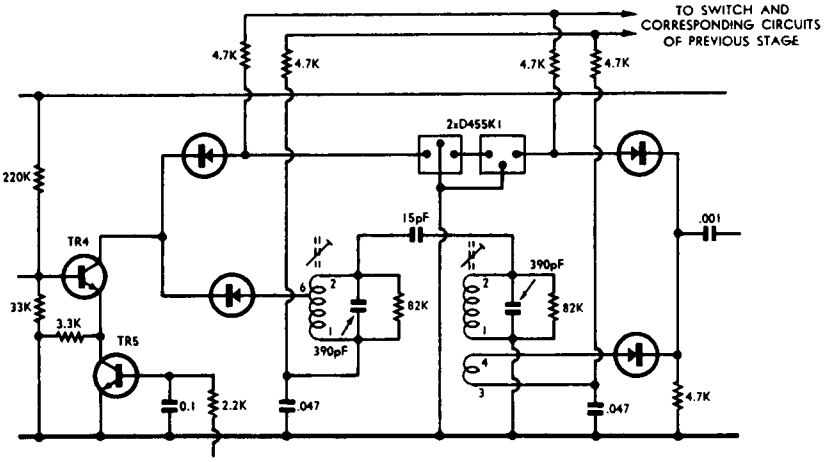
In the case of TR8, replacement could only be affected if the bias conditions are changed to suit. The 120K base resistor will need to be increased until the collector voltage is of the order of 4.0 volts. The 47-ohm emitter resistor should also be increased to about 100 ohms, or to such a value that ensures no overloading of this stage from the detector.

The tuning meter does not allow

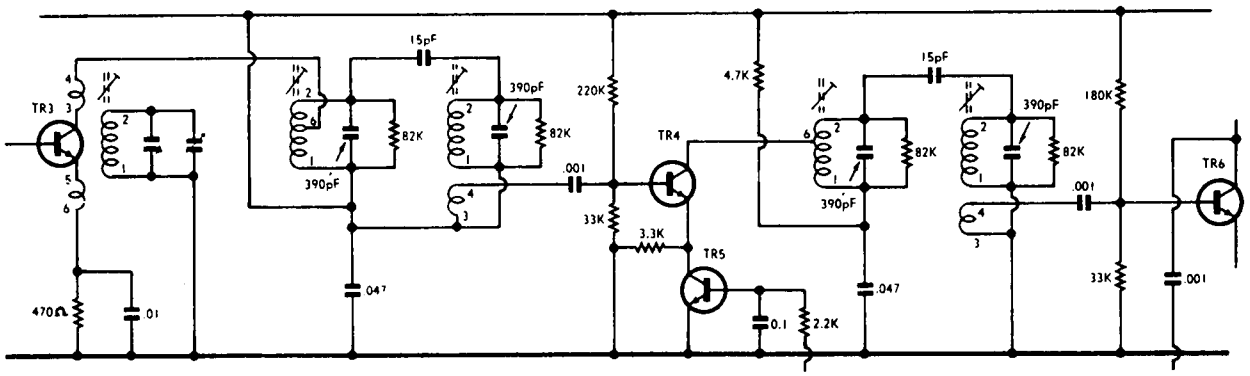
much opportunity for changes, due mainly to the need for a meter having a similar shape to the one which has been used on the prototype. However, within this restriction, there is another meter in the same range, scaled as an "S" meter. This has a less sensitive movement and needs a shunt resistance value of 100 ohms, instead of 56 ohms, to give a comparable scale reading. This tuning meter is slightly faster in its action than the original one used and this can be a slight advantage.

A number of possible economies may suggest themselves and we mention them with the reservation that the constructor may too casually leave out a facility which he may need to add later on.

Where a listener is convinced that he will need only certain local stations and that they will always be usable with the selectivity set to the wide position, it would conceivably be possible to omit all the circuits needed



The circuit of the second pair of IF transformers, is very similar to that for the first pair. Differences are due to need for compatibility between the alternative systems for this stage.



For readers who wish to dispense with the sharp selectivity position, here is the complete circuit which shows the modifications. Full details are covered in the text.

for sharp selectivity, with a consequent saving in initial outlay.

The following components will not be needed between the mixer-oscillator and the first IF amplifier: One ST45C IF transformer, four OA91 germanium diodes, one .047uF capacitor and one 4.7K resistor. In the following stage, between the first and second IF amplifiers: Two D455K1 ceramic filters, four OA91 germanium diodes and four 4.7K resistors. In addition, the DPDT toggle selectivity switch will not be needed.

This suggested modification is shown in an accompanying circuit, in which you will notice that we have used the alternative arrangement to the wide band ceramic filter. If economy is a vital factor, this approach would probably be preferred, anyway.

In the assembly process, apart from omitting the unwanted components, it will be necessary to replace the four germanium diodes associated with the wide band switching, with wire links. As the toggle switch is not used, an insulated wire link must be run from switch point 2, to the corresponding point 3 on the board. In addition, the two 4.7K resistors immediately above switch point 3 are omitted and a wire link run in place of the .047uF capacitor, just to the right of switch point 3.

Alignment with this arrangement may not be as easy as with the original with its sharp selectivity position, which makes identification of the centre frequency of the IF strip quite easy. Due to the broad nature of all remaining circuits, finding the precise centre IF frequency is more difficult. The object of this exercise is to use the resonant frequency of the D455K3 ceramic filter. One way of doing this would be to use a signal generator. A suggested procedure is as follows:

Apply the output of the generator, set to 455KHz, to the base of the buffer-amplifier TR7. Rock the generator frequency about 455KHz and determine the point of maximum response on the tuning meter. The generator output level must be adjusted to give a satisfactory reading on the meter. The centre frequency having been found, the rest of the IF circuits must be aligned with the generator and, in no circumstances, must the frequency be changed.

Now apply the output of the generator to the base of the mixer-oscillator TR3 and adjust the output level so that about three-quarters of full scale is obtained on the tuning meter. The four IF transformers are now adjusted by using the damping technique as previously described. Start with the transformer nearest the diode detector and work back towards the mixer-oscillator. It may be wise to stop the tuner's oscillator during this process and this can be done by shorting out the centre section of the gang.

When the IF circuits have been adjusted, the signal generator may be dispensed with and the band-pass tuner circuits should be adjusted by the method already described.

Leaving out the sharp tuning facility, a few dollars will be saved. Before rushing into this, we suggest that you take a good look at the situation and decide whether this is for you or not. Of course, if you adopt this approach and change your mind afterwards, you can still add the extra parts later.

Another modification which is possible, and one which we have been asked about, is the idea of eliminating the tuning gang and substituting a rotary switch. By using fixed capacitors in the tuned circuits and pre-set to one, two or more wanted stations, the station may be selected by the mere twist of the switch. We are not very enamoured of this one but it can be done if you really want to. For those hardy souls who wish to do this, we leave the details up to them.

The switch may even be eliminated and the bandpass tuner set to one station of your choice. The other thing which naturally follows, is the fact that there is no longer any need for a tuning meter. The leads from the board to the meter will be replaced with a shorting link.

The foregoing comments and suggestions should give quite a bit of food for thought to readers who contemplate building up the new wide band tuner. For those readers who wish to make the tuner up and fit it into a larger, free standing case, one is almost completed and we hope to present it next month. ■

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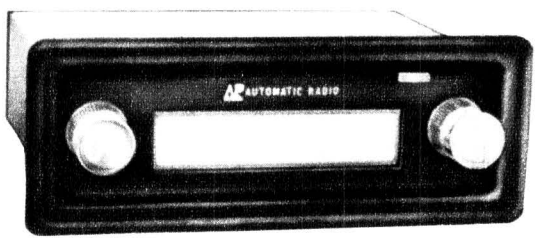

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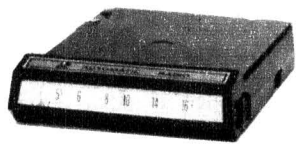

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In simple terms, what is meant by —

MICROELECTRONICS & INTEGRATED CIRCUITS *

Hard on the heels of semicondoctor diodes, transistors and other related devices has come a new revolution in the science of electronics: the integrated circuit and the new era of microelectronics. What is behind these terms?

Strictly speaking, the term integrated circuit signifies any group of circuit elements which is assembled, in the electrical and physical sense, so intimately that it must be regarded as an indivisible unit, rather than as a group of individual, accessible componnents. Dimensions are not significant to the definition.

However, in everyday technical language, the term is so often linked with tiny circuit elements of "micro" dimensions, that to say "integrated circuit" is virtually to signify "integrated microcircuit." Qualified or unqualified, therefore, integrated circuits are virtually part of the new era of microelectronics.

All this may sound like an exercise in technical jargon but it is not as remote, as might first appear, from everyday affairs.

Already integrated circuits have penetrated deeply into military and space electronic systems. And they are on their way to widespread adoption in industrial electronics. The average consumer is next, because integrated circuits mean less expensive and more reliable electronic equipment, from spacecraft guidance systems to home radio sets.

An integrated circuit, or IC, is a tiny "chip" of silicon about the size of this capital letter "O." Yet, built into it is the capability of an electronic circuit assembled from perhaps 50 separate components — transistors, resistors, capacitors, diodes and their connecting wires.

Integrated circuits save remarkably in the size and weight of electronic systems. But even more important is the contribution of integrated circuits to the reliability of electronic systems. Typically, the improvement over conventional circuitry is 10 to 1. The U.S. Air Force has cited life expectancies of 20 million hours—over 2,000 years —for ICs already in service. Even longer lifetimes lie ahead.

Integrated circuits got their big boost in 1958, when, in a pioneering contract with Westinghouse, the United States Air Force sought to implement a radical new approach, called molecular electronics, to the growing complexity of military electronic systems. A new approach was indeed badly needed: with existing technology, the working electronic components aboard a bomber had grown a dozenfold from the B-17 bomber to the B-58.

The Air Force - Westinghouse approach would bypass all existing and proposed techniques for making electronic circuitry smaller and lighter, since such techniques did not really come to grips with the overriding military problem—reliability.

Molecular electronics seeks to synthesise blocks of material, each capable of performing the function of an electronic circuit group. Hence the expression "integrated circuit" in its present-day connotation. Such circuits achieve the total circuit function in a solid piece of material by "building" desired electronic behaviour into separate regions and connecting them together internally.

Basically, the art of electronics depends upon an ability to control the flow of electrons in electrical circuits. Integrated circuits are the third generation of devices to do this.

The first generation involved the radio valve — or vacuum tube — first used for radio transmission and reception more than half a century ago. Valves vary in size and function from the huge rectifiers that supply power to an aluminium plant, all the way down to midget-size varieties. Certain electronic functions can be performed conveniently in no other way, such as the visual display of a television picture or the generation of X-rays.

Next, some 20 years ago, came the second generation of electronic control devices—the transistor and the host of other solid-state devices that sprang from it. They revolutionised the whole art of electronics.

Made on tiny slivers of germanium or silicon, they replace larger, more expensive, more power-hungry valves in everything from portable radios to the most complex communications and control equipment for spacecraft.

Today, the third generation, integrated circuits, has created its own electronic revolution. ICs have the same long-lasting performance as transistors, the same economical use of electric power, the same compactness and rigidity of a solid structure, the same inexpensive manufacturing techniques.

But where a single transistor once "grew" on the surface of a slice of silicon, now an entire electronic circuit takes form in the same amount of space.

Integrated circuits are direct descendants of the transistor family of solid-state devices and their principles of operation are similar. Basically, they rely upon the fact that the electrical properties of pure silicon can be modified "to order" by the addition of small but exact amounts of impurity atoms, called dopants. The impurities are added to the silicon by diffusing them into the crystal at high temperatures.

Doping of the silicon leaves it either with an excess or a deficiency of electrons in the region exposed to the impurity. For example, doping with phosphorus and arsenic, which have more valency — or "available" — electrons than silicon, produces an N-type (negative) region having excess electrons. Boron and indium, which have fewer "available" electrons in their atoms than silicon, produce a P-type (positive) region having electron vacancies among the silicon atoms.

The site in the crystal where N-type silicon and P-type silicon come together is called a junction. The movement of electrons and vacancies across such junctions explains the operation of semiconductor devices.

A diode is a two-layer device having a single junction between N-type and P-type silicon. Under an applied voltage, current flows in one direction across the junction more easily than it flows in the opposite direction. The diode thus acts as a rectifier capable of changing alternating current to direct current. Particular types of diode can be activated—or rendered conduc-

An engineer from the Boeing Company compares an aircraft system module, composed of discrete (i.e. separate) components on a wiring board, with an integrated microcircuit which performs substantially the same function. Besides the spectacular saving in size and weight, the IC offers far greater reliability.

* ***From an article supplied by Westinghouse Electric International Company, 200 Park Av., New York, 10017 U.S.A.***

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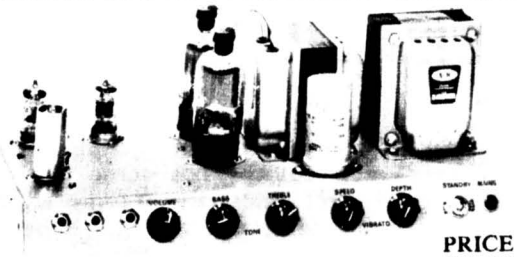

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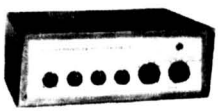
Fuzz Box Kit .. .. **$12.95** (plus 75c postage).



The new INSTROL-PLAYMASTER 115 SOLID STATE STEREO AMPLIFIER ("Electronics Aust.," April-May, 1967).

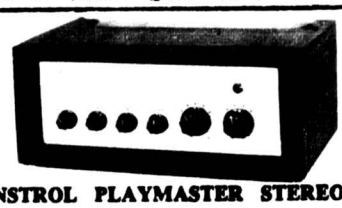
A fully transistorised 10 Watt Stereo Amplifier using the latest F.E.T. high-efficiency transistors.

Crystal/Ceramic Kit **$95.00**
Magnetic kit extra **$10.50**

INSTROL-PLAYMASTER 106 AMP/TUNER ("RTV and H," Dec., 1963).

A high-quality amplifier/tuner with all stations clearly marked on dial. Amplifier 10 watts per channel.

Kit of Parts **$96.50**



INSTROL PLAYMASTER STEREO AMPLIFIER No. 118

("Electronics Australia," July, 1967)

Kit of Parts (Less Case) .. **$82.53**
With Metal Case **$86.53**
With Teak Case **$100.03**
Magnetic Pre-Amp Kit **$16.15**

TEST EQUIPMENT KITS

Send for Catalogue

Millivoltmeter ..	Jan., 65	$46.19
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R.C. Bridge	May, 66	$40.99
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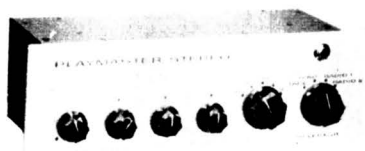
3" C.R.O.	May, 66	$125.99
Impedance Meter	March, 65	$37.16

Postage extra on all kits.



INSTROL-PLAYMASTER 120 CONTROL UNIT

("Electronics Aust.," Feb. 68)

A versatile, hybrid control unit which can accommodate crystal, ceramic or magnetic pick-up cartridges. Incorporating input/output facilities for use with tape recorders.

Kit of Parts .. $44.41.

ELECTRONIC TOOL KIT
For Servicemen and Hobbyists.

Comprises:—
1 Soldering Iron 240V (Aust.); 1 Set 3 Spanners; 1 Coil Resin Cored Solder; 1 Pair standard pliers; 1 Pair Long Nose Pliers; 1 Pair Side Cutters; 1 Pair Tweezers; 1 Screw Driver Set; 2 Screw Driver Bits; 1 Philips Driver Bit; 1 Pointed Awl; 1 1-8 Spintite.
Complete in attractive zip-fastened carrying case.
Price $11.00. Plus Reg. Post, $1.00.

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☐ Playmaster ☐ Test Equip Kits
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107 Amp/Tuner	$81.80	$2.00
108 Amp/Tuner	$69.80	$2.00
101 Amp	$61.00	$2.00
No. 3 Amp	$57.80	$2.00
10W U/L Amp	$85.80	$2.00
No. 10 Control Unit	$39.00	$1.20
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Playmaster Designs are also available Completely Built and Tested.

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High-quality, pre-fluxed boards to suit the 115 Amp. Clearly printed on reverse side with component location map. Easy to assemble.

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Crystal Pre-Amp .. .. .. **$2.00 ea.**
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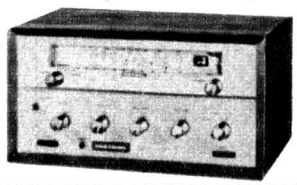

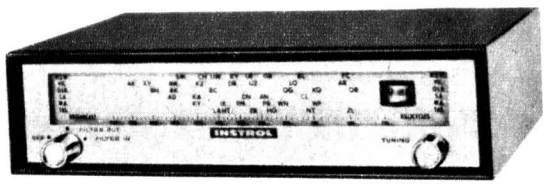

INSTROL MODEL 20-20 STEREO AMPLIFIER

Solid state, 20 Watts per channel max power 10w. R.M.S.) 30 to 20,000 Hz — less than 1½% harmonic distortion, suits ceramic and magnetic pickups — packed with features.

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10 Watts per channel, 5w. R.M.S. M.S.) ideal for ceramic and crystal pickups. High quality at low cost.

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T101 TUNER (in metal case)	$72
20-20 AMP' (in teak case)	$99
10-10 AMP' (in teak case)	$58
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Combined 10-10-T101 in teak case	$135

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In this Electronic Age, every person should have some knowledge, however elementary, of "how it works." The new Instrol 20 in 1 electronic kit will enable you to understand in an absorbing, simple manner the basic principles underlying computers, satellite communications, industrial electronic devices, etc., etc. You make 20 different experimental circuits, including 10 working radio transistor operated radio circuits. Audio Amplifier circuits, home intercom, testing circuits including Audio Frequency Oscillator and Signal Tracer, Morse Code practice set and telegraph transmitter, etc. .You use and learn about the amazing SOLAR CELL.

NO TOOLS OR SOLDERING IRON REQUIRED

All components pre-wired, ready for clip-on assembly. 50 page Instruction Manual supplied.

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Special quantity purchase enables us to offer you this world renowned recorder at the ridiculously low figure of $56.00 for a limited period only.

So simple a child can load and operate the Instrol Compact Cassette Tape Recorder. It may be used virtually anywhere for both speech and music, under almost any conditions. At picnics—in the home—at meetings—in the car—by Salesmen and Executives in the field—and most important—in the office as a complete dictating system. Headphones, footswitch and A.C. power unit, which are available as optional extras, combine to make Instrol Model 33 a personal, highly efficient, and really low-cost dictating system suitable for both large and small offices, smart Teak trim, simple piano key-type operation, snap-in cartridges, microphone with on-off switch for remote control, light (weighs under 4lb), full 1-hour playing, outstanding performance with built-in speaker and remarkably efficient when connected to a large external speaker.

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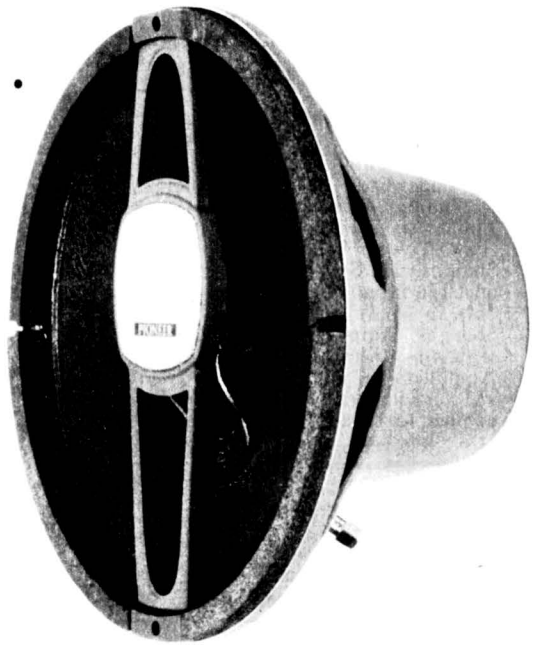
Remember what we said last month?

Take as an example . .

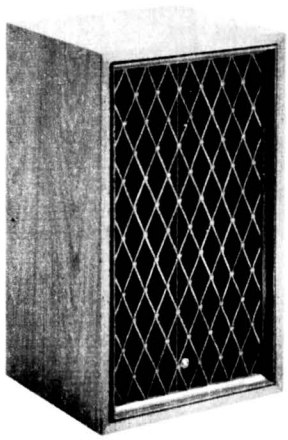
The PAX-25B



Fundamental Cone Resonance	40—50cps
Frequency Range	35—20,000cps
Maximum Power Handling Capacity	20 watts
Rated Capacity	15 watts
Output Sound Pressure Level	102 db/watt
Crossover Frequency	3,000cps
Total Magnetic Flux—Woofer	105,000 maxwells
—Tweeter	17,000 maxwells
Flux density—Woofer	10,000 gauss
—Tweeter	11,000 gauss
Equivalent Mass	20 grams
External Diameter	10 1/6"
Depth	5 5/8"
Mounting Dimensions	9 9/16"
Baffle opening Diameter	8⅝"
Weight	6⅜ lbs.

Easily the best proposition for the budget-minded do-it-yourself enthusiast. Comes with complete plans for 2 different enclosures, or build it into a drainpipe, a fireplace, or a dividing wall, the PAX-25B still performs superbly. Priced at only $26.00 Retail. Two for $52.00 gives stereo quality unmatched by others at twice the price—Ask your PIONEER Dealer.

Or on the other hand . . .



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Features 5 perfectly matched speakers giving amazing smoothness and the depth of a superb true bass without boom or doubling. If you have an amplifier good enough the CS-88 will deliver 60 watts of pure music exactly as recorded without coloration.

In your lounge room, using only a few watts it will deliver the cleanest, smoothest sound you ever heard. Look at the specs.:

12" Woofer	Sensitivity 99 db/watt
5" Mid-range speaker	Dimensions 14.3/16 (W) x 24.3/16
Horn tweeter x 1	(H) x 13 (D) inches
Cone tweeter x 2	Weight 48lbs.
8 ohms	
25—20,000 cps	
60 watts peak	

PIONEER®

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THE QUALITY NAME IN HI-FI MUSIC EQUIPMENT FROM GOOD DEALERS EVERYWHERE

tive — by light and other forms of energy as well as by a voltage.

A transistor is, essentially, a three-layer sandwich (two junctions): (1) an N-type region between two P-type regions (PNP), or (2) a P-type region sandwiched between two N-type regions (NPN).

Electric current flows into and out of the transistor's two outer regions, while the middle layer acts as the control element to govern the flow. Thus, the middle region can be compared to the control grid of a three-element electron tube (or triode) in which small voltages on the grid can control much larger voltages and currents in the output of the device. There fore, the transistor, like the tube, is an amplifier.

Junctions which form the basis of diodes and transistors can be used to simulate another essential circuit element—a capacitor—in which electric charges are stored and then discharged at will. A still further circuit element, the resistor, is formed by altering the inherent electrical resistance of the silicon itself.

Thus, by proper choice and control of the impurities added to regions in a wafer of silicon crystal and by proper processing of it, a complicated circuit made up of transistors, diodes, capacitors and resistors can be built into the crystal and interconnected as the circuit function dictates.

The manufacture of integrated circuits requires massive technological know-how and equipment, but precious little of the actual stuff of which the devices are made. Yet, curiously, the silicon used to make them is the second most abundant element on the face of the earth.

The sand on the beach and various rocks scattered across the land contain vast amounts of silicon in chemically combined form. But the silicon used in making integrated circuits must be very pure indeed—some 99.9999 per cent pure, in fact.

The highly pure silicon begins as a solid round bar, about 1¼-inch in diameter and one or two feet long, which is drawn by a crystal-pulling apparatus from a pool of the molten material.

Then the cylinder is sliced, like a loaf of bread, into silicon wafers about as thick as a fingernail—or some five to 10 mils. These wafers are polished, or lapped, to mirrorlike smoothness, since surface imperfections cannot be tolerated in the tiny, finished integrated circuits.

The wafers go into a furnace where they are heated and exposed to the vapour of a silicon compond, which deposits a thin film of single-crystal silicon on their top surfaces—very pure and with a uniform lattice structure. This film, called the "epitaxial" layer, is then doped with an N-type impurity gas fed into the furnace.

To protect this surface, the wafer then goes into another furnace having an atmosphere of steam. The steam reacts chemically with the silicon to build up a layer of inert silicon-oxide.

From here on, processing of the wafer consists of a series of photographic and chemical reactions on this top surface, each time protecting the work that has been done with a layer of silicon-oxide.

A set of masks for an integrated circuit. Already substantially reduced from the original drawing size, the masks are used ultimately to produce a large number of individual pin-head sized patterns side by side on the surface of the original wafer, itself about an inch in diameter.

Each integrated circuit begins with the design of the circuit and its reproduction on a set of acetate masks similar to photographic negatives. These masks are about 400 times the dimensions of the finished product and are cut to an accuracy of 2/10,000ths of an inch. Several different ones are required for the successive steps needed to make a particular device. By photographic duplication, a single set may reproduce the circuit up to 1,000 times in a checkerboard pattern on one silicon wafer.

To form the circuits, the oxide-coated wafer is covered with a layer of material sensitive to light. This surface is exposed to ultra-violet light through the first photomask, thus exposing the wafer surface somewhat like taking an ordinary photograph.

The wafer is then dipped in an acid to etch away the oxide layer that has not been exposed to light. In another furnace, a P-type impurity is diffused through these "windows" in the oxide layer. The wafer is recoated with oxide re-exposed through a second photomask, etched and diffused with an N-type dopant. A third, and perhaps additional steps, complete the interconnections and other elements of the final circuit.

Finally, the wafer is separated into its several hundred "dice," or "chips," for electrical testing, attaching of lead-in connections and encapsulation into a metal or plastic container.

The entire process is known as the "planar epitaxial diffusion" process.

The manufacturing processes just described result in what might be called a "true" integrated circuit or, more exactly, a monolithic silicon integrated circuit.

There are, however, integrated circuits that are modifications of this monolithic structure. One is called a "hybrid" integrated circuit.

In this device, the transistor and diode regions (the active elements) are made as usual, but the capacitors and resistors (the passive element) and the interconnecting "wiring" are then formed by evaporating a metal film on top of the active elements.

It is an interesting fact that these passive elements—which are the cheapest components of ordinary electronic circuits—are, in the case of ICs, the most expensive. The costs of the elements in the circuit are roughly proportional to the space they take up on the chip. Resistors and capacitors take up the most room and are more costly than transistor or diode areas. IC engineers try to use active semiconductor elements as capacitors or resistors for exactly this reason.

Another type of integrated circuit is the multiple-chip device. Here, the active and passive components are formed on separate chips which are then mounted on a common base and interconnected with thin gold wires.

The manufacture of integrated circuits must be performed in an ultra-clean environment. The Westinghouse molecular electronics division plant in Elkridge, Md., was opened in 1963 as the first facility in the electronics industry devoted exclusively to the manufacture of integrated circuits.

The plant is of modular design, consisting of square sections about 130 feet on a side. Each is self-contained, with its own plumbing, air handling and other services. All of the outside walls and entrances are built so that they can become inside walls and doors for subsequent expansions. Thus, new construction is placed against the existing plant structure without upsetting the delicate balance of temperature, humidity and cleanliness maintained in the plant.

More than 75 per cent of this plant is composed of clean rooms where workers wear lint-free gowns and caps and use automated equipment, microscopes, vacuum pencils and similar apparatus to process and handle the wafers and tiny "dice."

Special handling techniques prevent contamination by perspiration and oil from the fingertips. Pressurised air gives a dust-free environment, since even a single speck of dust would be more massive than one of the working sections of an integrated circuit.

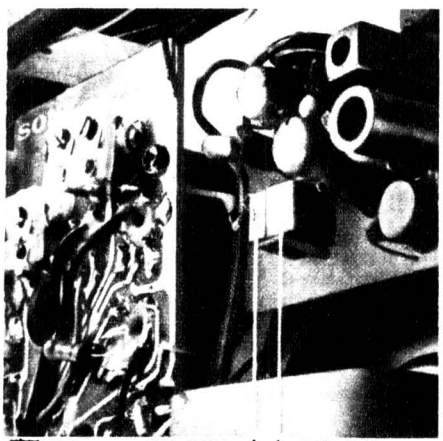
After the wafer is cut into its individual "dice," these are handled under a microscope. Spider-web strands of pure gold, about one-third the thickness of a human hair, connect the working areas of the integrated circuit to lead-in wires that are heavy enough to be connected into electronic systems by normal production methods.

Each circuit is sealed into a "flat-pack," or epoxy package, or is cemented into position inside a small metal container. Each is run through a broad series of final tests. Highly automated test equipment performs these tests in fractions of a second.

A typical production lot is about 5,000 integrated circuits—each of them capable of performing the same function as 50 or more separate components. Production and material costs for the 5,000 circuits are ultimately expected to be less than the cost of 5,000 separate transistors.

Already, integrated circuits are earmarked for military applications extending from outer space to the depths of the sea. The Apollo manned spacecraft program is a major user, as is

Sony replaced IFT in this 4-band transistor radio with the new Murata ceramic filter SF-455D.



BF-455A ⌟ ⌞ SF-455D

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ACTUAL SIZE

SF-455D

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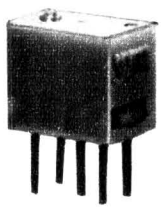
Sony engineers have taken advantage of these benefits and have incorporated two Murata Ceramic Filters SF-455D and BF-455A in the quality model TR-1000 4-band transistor radio.

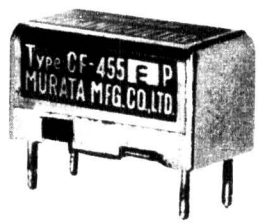
Combining excellent overall response and selectivity characteristics with space saving and production economy, the Murata Ceramic Filters are proving superior to conventional IF transformers.

Include Murata Ceramic Filters in **your** next design.

MODEL BF-455A improves the selectivity of transistor radios when used as an emitter by-pass in transistor IF Stages.



SERIES TYPE (Model SF-455) is a resonance type filter of 455 Khz. It replaces the transistor radio's IFT or can be used in combination with IFT's.



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The dependability and weight-reducing characteristics of ICs make them ideally suited for electronic equipment that must be carried in the field or worn by ground troops. The circuits are being used in advanced ground-to-air tactical radars weighing only 50 pounds. Further development will make it possible to build small radars to seek out the enemy in adverse terrain and help direct machine-gun fire by the infantry.

For industry, Westinghouse is producing numerical control systems using ICs which offer computerised operation of small milling machines, automatic punches and complex positioners which work in three axes. This control system does the same job with less than one-fifth of the 11,000 components and 30,000 connections in older units using transistorised techniques.

In the consumer market, Westinghouse introduced the first such application, a class-B amplifier, in a tiny hearing aid manufactured by Zenith. Audio amplifiers on a single chip and other commonplace circuits are going into home entertainment equipment made by many manufacturers.

The applications of integrated circuits are coming so thick and fast that it is difficult to forecast their future even over the next few years. One can visualise the day when small, reliable ICs may be implanted in the human body to serve as hearing aids, heart pacers and monitoring devices.

Desk-top computers will be smaller than a typewriter and inexpensive enough to have in the home. They would keep track of the household budget, maintain personal checking accounts, monitor the supply of food and other items and work out the income-tax.

Everywhere, computerised equipment may become as standard as the chequebook. Equipment already has been developed to pay monthly bills by inserting a personal credit card in a telephone and dialling a prescribed code. Apparatus at the bank would automatically debit your checking account and credit the account of the creditor prescribed in the dialled code.

Westinghouse has built a television receiver the size of a portable radio. Small two-way wrist radios also have been built with ICs.

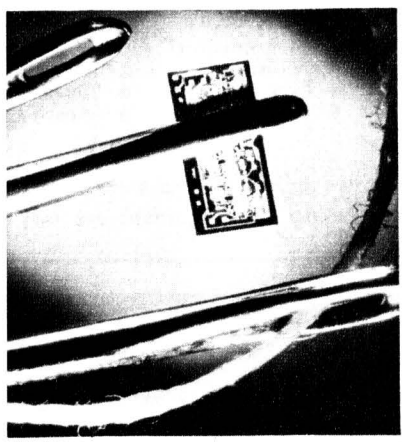
Integrated circuits will find their way into tomorrow's automobiles. They will be used in the panel instruments, ignition, radio, tape player, TV, voltage regulator, controls for the windshield wipers and air conditioner, and in many other places. These tiny units also will be in the controls for the home refrigerator, dishwasher and laundry equipment, in home entertainment equipment now available and still to be developed, and in the communications devices of the future that will bring to every household the morning newspaper, and radio and TV entertainment on a laser beam. They may even contribute, at least indirectly, to some of the other ideas which engineers dream about, such as TV telephones and flat, hang-on-the wall TV display panels.

Integrated circuits represent the fastest growing development in the entire history of the electronics industry. From a "blue sky" idea in 1958, ICs became an infant industry in 1962. By 1970, the IC industry is expected to be a $500 million business.

This rise in the gross figure is in spite of the fact that the cost of integrated circuits has decreased steadily since their commercial introduction. Typically, those in the $100 range in 1962 now sell for as little as $2.

Continuing developments in IC technology have produced "hidden" improvements in such areas as better production facilities, better testing methods, closer quality control and better materials handling. These add up to a better product, with higher reliability and lower cost.

The Marconi-Elliot microcircuit assembly plant, claimed to be the largest in Britain. With two associated plants in Scotland, the Company has the capacity to produce 5,000,000 microcircuits per annum.



A typical microcircuit, before encapsulation, photographed in the eye of a needle and against a strand of 40g sewing cotton. Measuring 3 x 0.5mm, the microcircuit contains 56 transistors, 28 diodes and 52 resistors, complete with interconnections. The same circuitry involving normal components would spread over an area of about 150 x 40mm. (Mullard photograph).

The more spectacular technical developments, however, show up as virtually new products—more versatile in their performance, more useful in their applications and, very often, capable of carrying out entirely new functions.

A typical product of such advanced technology is a technique known as large-scale integration, or LSI. It works like this:

Typically some 200 to 500 individual ICs are fabricated on silicon wafer. Present practice is ultimately to slice the wafer into its separate circuits, to test them all individually, to encapsulate them, and then to connect them together into the final electronic system.

Large-scale integration keeps large sections of the wafer intact. All of the tiny ICs are tested by computer and all that meet specifications are interconnected right on the wafer by a suitable wiring pattern. Thus, a complete electronic computer, where most of the circuits are a repetition of each other, can be composed of relatively few larger pieces rather than many thousands of individual ICs.

Some day integrated circuit technology may permit the tiny devices to be designed by computer, which would then "draw" the circuits on a substrate with an electron beam or laser beam, from which pattern they would automatically be processed. A secondary outcome of such beam technology would be an increase in the number of ICs that could be placed on a wafer by perhaps a hundred times or more.

Another area of technology is the work being done to tune, or select desired frequencies, within integrated circuits. Recently, Westinghouse has developed such a solid monolithic device as a separate entity. The device, called a resonant gate transistor, does its tuning with a vibrating sliver of gold much thinner than a human hair. The techniques for making the transistor are compatible with those used in producing ICs. The next step is to incorporate the device, or one which performs its function, directly into the integrated circuit. ■

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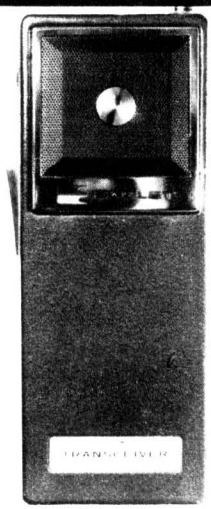

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- 14 transistors
- Longer aerial
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Also Tokai TC9 and 911 without Squelch **$44.75 each.**

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1928		285-0-285	150	6.3	1	6.3 2A Tap at 5V 2A 6.3ct 2A
1937		300-0-300	200	5	3	6.3ct 3A 6.3ct 3.5A
5892		270-0-270	150			6.3ct 4A 30V .01A
		(For use on Electronics Aust. 40W Guitar Amp.)				
2064		135 Tap 125	125	6.3	2.25	6.3ct 2.25A
5509		Prim. 240v	50cps	12.6	5 or 25.2	2.5A
2155		Prim. 240v	TV Booster	6.3, 7.5, 8.5, 9.5, 12.6 & 15	1A	
5990		Prim. 240v	50cps	17V	1A	Mullard Stereo Amp.
6413		Prim. 240v	50cps	32V	2A	
2161		Prim. 240v	50cps	3V 100 Watt int.		Scope Birke Solder Iron

Type	OT	Prim.	Sec.	Watt.	Typical Use
2558		10k S.E.	2, 3.7, 8, 15	3	Playmaster No. 1 Mullard 2-2
2625		10KCT.	2, 3.7, 8, 15	7	P.P. 6AQ5, 6BM8
2626		4K S.E. 2.5K	2, 3.7, 8, 15	10	EL34, 6CW5, 807, 6L6, EL37
2634		3,400 CT	500, 250, 125, 82, 62 +F. Back Winding 9 ohms	35W	P.P. 6CM5, EL37, 807, P.A.
2747		8KCT 6.6KCT	2, 3.7, 8, 15	35W	P.P. EL34
2748		3,400 CT	2, 3.7, 8, 15	55	P.P. 6CM5, EL34
4007		8,000 CT	3.7 or 15	10	Mullard 5-10 U/Linear
4013		6,600 CT	3.7, 8, 15	15	Mullard 5-10 U/L 20% 15W.
4018		8,000 CT	3.7 or 15	10	Miniwatt Twin 10
4020		9,000 CT	3.7 or 15	10	Mullard Stereo 10-10

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A READER BUILT IT!

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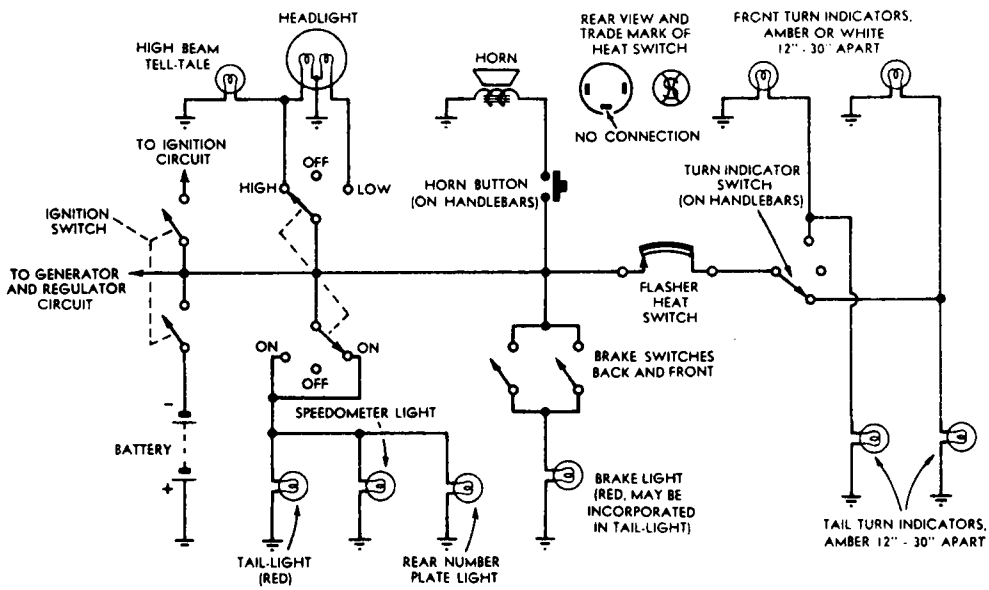
ELECTRICAL WIRING DIAGRAM FOR A MOTOR CYCLE

This month's Reader Built It item may be of assistance to those who happen to share their interests between electronics and motor cycles. It comes from Mr. L. Ford, 33 Burroughs Rd., Balwyn, Vic. 3103.

With the recent influx of motor cycles on to Australian roads, many youngsters have either bought or rebuilt second-hand machines in which the electrical system is virtually non-existent. These systems are stringently checked, nowadays, and must operate in conformity with regulations before a certificate of roadworthiness will be issued.

In any case, it is in the rider's own interests that the electrical system be reliable, since a sudden blackout on a road at night can spell tragedy. Many amateur "unofficial" installations are all too prone to this kind of fault.



The suggestions should also be of interest to anyone who owns a motor cycle built prior to about 1955-60. At that time, there was no law, as there is now, compelling the owner of a motor cycle to have turn indicators and many motor cycles even passed their roadworthiness test without a headlight dipping device.

For such bikes to be re-registered, these provisions must be incorporated.

The lighting circuit which I have used is a result of a good deal of checking around and is reliable, legal and not too expensive. Even so, before proceeding to wire a motor cycle, it is a good idea to send for a sheet from the Automobile Chamber of Commerce or an equivalent body in your State, to find out allowable lamp wattages, colours and dimensions.

Wires should not be exposed but should be passed through holes to the inside of the frame and handlebars. The holes should be dressed and the wires passed through sleeving to prevent possible chafing.

For the brake switches, it is suggested that commercial units be purchased and arranged so that they will operate as the brake mechanism engages. It is possible to rearrange the circuit and use a home-made switch in which the brake mechanism "earths" a spring-steel leaf, insulated from the frame. However, the writer's experience indicates that home - made switches of this type tend to be unreliable, due to fouling and rust, and the commercial product is better and worth the extra investment.

The flasher light heat switch which I used is a recommended type. It is of German manufacture, unbranded but can be identified by the marking shown and is connected as indicated.

Wired as shown, the ignition switch isolates the battery from the supply line at the same time as it kills the ignition. This helps to safeguard the cycle if a fault occurs in the wiring while the vehicle is garaged. It also obviates the risk of a run-down battery if the rider forgets to switch lights off when he parks.

The ignition, generator and regulator circuits will vary with the type of cycle. They should be used in their original form and reconditioned, if necessary, by replacing wire for wire.

EDITOR'S NOTE: Isolating the battery from the generator as shown would prevent it from discharging through the generator in the event of a failure of the cut-out or cut-out diode. It could, however, result in a sharp rise in voltage during the period when the generator was still spinning at speed but with no battery connected. The more usual automotive practice is to rely on the cut-out or cut-out diode to isolate the battery and to wire any additional pole of the ignition switch to isolate all other wiring except, perhaps, to the lights. ■

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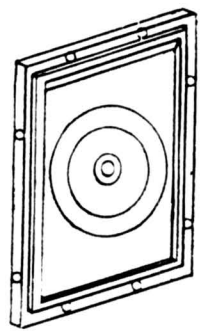

For the serious listener may we recommend the Peerless 15" 3-way speaker system. Comprising the following speakers: 15" Woofer, 8½" midrange and four 2½" Tweeters with constant impedance crossover unit. This system is from the Peerless Professional range, and allows an absolutely smooth response from 25-18,000 Hz with a maximum power input of 40 watt RMS. Finished in superb hand rubbed enclosures this magnificent system is available at **$500** complete set.

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SOLID STATE SERVICING — IN PRACTICE

Last month I made a few comments about the advent of solid state devices into the servicing field, and the problems they present by reason of their circuit techniques and the physical construction, neither of which bear much resemblance to the old valve socket and chassis device.

As if to emphasise the point, a job which came to hand just after I had written those notes must surely establish some kind of a record for curly faults in solid-state devices. In fact, it was more than a curly one; it was a double curly one.

The set was a portable transistor radiogram, battery/mains powered, of obscure English make, and featuring a gramo—medium wave—long wave rotary switch. It was delivered to the shop by the lady who owned it, and, in reply to my usual question, she explained that the radio position did not work—or, at least, this was the main fault. The radiogram didn't work either, due, she suspected, to a faulty cartridge. Since she seldom used this part she hadn't bothered about it until now, but supposed she might as well have it all fixed while it was in the shop.

As with the old valve sets, a good place to start with any dead set is at the volume control. For one thing it is a part of the circuit which is easily recognised — doubly important when faced with the meaningless jumble of a printed wiring pattern — and for another, it divides the set roughly in half, thus indicating in which direction one should proceed to avoid wasted effort.

And, as with valve sets, a finger, or finger extended with a screwdriver blade, is a convenient source of signal with which to make a preliminary test. True, the reaction in the speaker is unlikely to be as violent as it is in a valve circuit, but one can usually expect a healthy blurp. Such was the case now, suggesting that everything from the volume control onward was functioning and that the fault lay somewhere towards the aerial end. It also seemed to confirm the owner's suggestion that the radiogram fault was due to the cartridge.

That much established, I turned to the IF section. Setting the signal generator to 455KHz I worked my way through the IF section as far as the mixer oscillator. As far as I could see, everything was normal so far. Moving to the base of the mixer, I reverted to the finger and screwdriver technique, which proved its effectiveness by producing loud signals from the speaker. The only snag was that there was quite a mixture, involving what appeared to be a couple of broadcast stations and a steady stream of Morse code. The effect was tunable, at least to the extent that one could tune from one jumble of stations to another.

Well, at least the oscillator was working, thereby confining the trouble to the extreme front end; aerial coil, switching circuits, etc. Still using the finger and screwdriver I traced the copper pattern along the board away from the transistor base, continuing to produce signals as I did so. All went well until I came to the end of the pattern and the circuit was taken over by a lug, which passed through a hole in the board.

Picking up the trail on the other side of the board, I realised that the lug represented the moving arm of one section of the three-position switch, which selected the two tuning ranges or the radiogram function. The only snag was, the finger now seemed to have lost its magic. While it continued to work fine when I returned to the other side of the board, it had no effect when applied to the switch contact.

At this point I had best explain the mechanical set-up. The switch wafer was stood off the wiring board by about half an inch, supported on spacers. In all but one respect it was a normal "Oak type" switch wafer, mounted with the lugs facing toward the board. The exception was the addition of what might be termed an auxiliary lug, secured by the same rivet as held the main lug, but which was much longer and much thinner than the normal lug. In fact, it was thin enough to pass right through the wire anchoring hole in the normal lug, which it did as part of the normal assembly.

I imagine this was simply a convenient way of modifying a standard switch wafer to make it suitable for printed wiring boards. In any case, it was the long thin lug which passed through the board and was soldered to the copper pattern.

Or, at least, that is how it appeared. Yet I could produce signals by touching this lug on the copper side of the board, but absolutely nothing when I transferred the screwdriver blade to the same lug as it emerged from the opposite side. Yes, the lug was broken; and exactly midway through the board, where it was completely hidden. A short length of wire replaced it very effectively and restored the set to normal operation.

Now that the fault was pinpointed, the reason for the jumble of signals was evident. With no tuned circuits ahead of the mixer, the latter would respond equally well to at least two signals; one below the local oscillator frequency by 455KHz (the one normally received) and one above the local oscillator frequency by 455KHz (normally called the "second spot"). In addition, cross modulation and beating between signals could add to the jumble.

Why had the lug broken? And why there? Your guess is as good as mine. While the wafer could and did flex a little as the shaft was rotated, the

A LITTLE KIWI TOLD US . . .

Remember the story your Serviceman told, back in July, 1966, about a portable tape-recorder and the job of fitting it with nickel-cadmium batteries in place of the "dry" lead-acid battery originally supplied? Well, here is an interesting sequel.

Some time ago the New Zealand Broadcasting Corporation acquired a number of portable tape-recorders of the same type. For the first few months all went well, until staff members realised that playing times from the batteries were becoming shorter and shorter. Soon they had to be discarded altogether. Faced with the high price of replacement batteries, and considering the apparently short life which they would provide, those responsible decided that it would be cheaper to use ordinary "D" size dry cells.

These were tried, but presented another problem. It was difficult to keep track of the amount of use any one set of cells had received and, therefore, to know when to discard them. Operators frequently claimed that they had used a new set of cells for only a few minutes, yet the next person to use the recorder would find himself stuck with a set of flat cells in the middle of an important recording. The alternative was to discard all cells which had received any use at all, but this was obviously wasteful, as well as having a high nuisance value.

Finally someone drew their attention to the above-mentioned Serviceman article. As a result, all the recorders have now been fitted with nickel-cadmium cells, and everybody is very happy with the result.

Well, glad to have been of service.

movement was almost insignificant. It alone could not have been responsible. I can only assume that the contact had been damaged, either when it was originally punched out of the sheet, or during subsequent assembly, to such an extent that it was already nearly severed. Assuming that such a defect had not been detected by the time it was assembled on the board, it would thereafter be hidden. Subsequently, the slight flexing of the wafer could have completed the break.

Well, that was that. A tricky fault tracked down and cured. And in an unfamiliar set, too. I was feeling quite pleased with myself (who said solid state devices were hard to service? Etc.).

It was approaching that time of the afternoon when I normally treat myself to a cup of brew, so what better time than now to relax for a few minutes. I left the set playing on the bench while I busied myself with teapot and associated equipment, then returned to the bench with the finished brew. While I sipped it I tuned over the band and satisfied myself that the set appeared to be behaving normally. It seemed that all I had to do was return it to the cabinet and that part of the job was done.

At that point I left the bench to rinse my cup, empty the teapot, and tidy things up generally. Imagine my reaction when I returned and found the set had gone completely dead. The first thing I checked was the main supply rail. Normally nine volts, it was now only a little above three, so it wasn't surprising that the set was dead. No one could expect the oscillator to work at that voltage.

Fortunately, the set was made in three sections; a tuner board, an audio board, and a power supply. This made it relatively easy to disconnect the tuner supply line from the audio board, leaving the audio board as the sole load on the power supply. The voltage remained substantially the same. But when I disconnected the audio board from the power supply, the voltage shot up again. So, was it a fault in the supply, or excessive current drawn by the audio board?

Almost as I posed the question to myself, I became aware that the two output transistors were quite hot; certainly hotter than they should have been. A voltage check across the common emitter resistor suggested that the current they were drawing was much higher than it should be.

The output stage appeared to be a conventional class B arrangement, employing two older-type germanium transistors. These were fitted with flag type heat sinks, mounted in turn on the output transformer, one against each end. Thus the transformer was also a heat sink. In fact the transformer was also quite hot, but which way the heat was moving I had no way of knowing. Or, to put it another way, was there a fault in the transistor circuit, causing excessive current, overheated transistors, and a rise in transformer temperature? Or was there a fault causing a rise in transformer temperature, a rise in transistor temperature, and excessive transistor current as a result?

Either way, it seemed that the transistors themselves were the least likely suspects, partly because this is a fairly natural asumption anyway and partly

because both transistors were exhibiting the same symptom, suggesting that it was some factor common to both. I checked the driver transformer for both continuity and, more important, possible leakage between primary and secondary. All was in order. I checked the bias resistors. All in order. I checked the output transformer for possible leakage from primary to frame or secondary winding. All in order. Which just about exhausted the likely possibilities, apart from the transistors themselves.

Shorting the base of each one, in turn, to earth reduced the collector current slightly, though by different amounts. Apparently the current was still under the control of each base, so the transistor must be functioning, at least in a fashion. On the other hand, transistors seldom fail by half measures, it's generally either "GO" or "NO GO." Nevertheless, the symptoms were sufficiently unusual to prompt me to try a new set of output transistors. It was about all that was left to try.

As I went to withdraw one transistor from its heat sink it came away with surprising ease — or, at least, part of it did. The transistor was an early type consisting of a glass bead, which contained the transistor proper, cemented inside a cylindrical metal can. It was the glass bead which had come away, leaving the metal can still secured in the heat sink. Very suspicious by now, I tried the other one. It was exactly the same.

Closer inspection showed that the cement which normally secures the glass bead inside the can had completely disintegrated, leaving the bead floating with no proper bond to the can. In effect, the transistors no longer had any contact with their heat sink. Small wonder they were getting hot!

It may have been possible to salvage the transistors by re-cementing the glass back into the can, but I felt it would be cheaper and more satisfactory to simply replace them. When I had done so, a long bench test confirmed that the fault was cured.

But what a trap. If I had imagined that the faulty switch was a curly one, this one certainly topped it. And both in the one set, too.

However, the real tag line came from the customer. When the job was finally completed and she took delivery, I mentioned this additional fault, if only to justify the charge involved.

"Oh yes," came the off-hand reply, "it used to do that. But—"she hastened to reassure me — "it always came back on if I switched it off and let it cool down."

Apparently she regarded this as a perfectly normal and reasonable state of affairs. She certainly hadn't thought it of sufficient importance to mention when she brought the set in for service.

Ah well, that's customers for you.

And speaking of customers, here is a trio of stories taken from the P.M.G. technicians' journal "Telegen," which indicates that they, too, have their "service" troubles. Although published mainly for their humour, two quotations from them, "We have learned never to doubt the sincerity of any subscriber's complaint," and "The customer is always right," are worthy of more serious consideration.

Both point up the absolute necessity for complete communication between customer and serviceman; a fact-of-life I have been trying to hammer home in these columns for years. When this communication breaks down the result is almost always a poorly executed job, with disappointment, inconvenience and frustration for the customer. After you have enjoyed your laugh, give this some thought. Here are the stories:

Some time ago in the Sydney metropolitan area, a fault was recorded to Complaints stating that each time the telephone was used a loud noise was heard coming from the ceiling.

On investigation by the area technician, no apparent technical fault was in evidence and the lead-in cable was completely underground and fed directly to the telephone instrument from under the floor. A number of test calls were made without any evidence of loud noises from any part of the house. The technician left after duly reporting: "No fault found."

The next day the same complaint was received and this time the area technician was accompanied by a senior technician. Once again a series of test calls were made and everything was again normal. The senior technician then called Area Control and was engrossed in a rather long discussion on the pros and cons of "abstract telephony," when suddenly a tremendous noise erupted from the general area of the ceiling.

Although shaken, the area technician had the presence of mind to dash outside and the solution to the problem was there for all to see. Our lessor's neighbour was in the process of hurling a second missile (half a house brick) on to the tile roof. It turned out that the two houses were on the same duplex telephone circuit and the "B" party expressed his displeasure on not being able to use his phone by the rather drastic method of signalling with "bangs."

To the amazement of both officers, a rather large area of the tile roof on one side of the house was damaged and the guttering sagged with a collection of half house bricks, and yet the lessee (an old lady) seemed quite unaware of this situation.

The problem was quickly remedied by making each service exclusive and the technician, who was young and agile, cleared the guttering of the half house bricks. We have no idea how the problem of compensation for roof tile damage was resolved, nor have we any idea of the final coding on the second fault docket; but we have learnt never to doubt the sincerity of any subscriber's complaint in the future.

★ ★ ★

"Once upon a time" a T.I.T. (technician-in-training), working in the exchange in a highclass residential area, was employed on the job that T.I.T.s seemed to get all to themselves, doing the "perms" (permanent loops; or, in layman's language, a receiver left off the hook). One number used to turn up quite regularly and when tested gave every indication of having the receiver off.

Application of the howler (a device to produce a loud audible tone in the subscriber's receiver) produced a most unusual result. If one pressed the head receiver hard against the ear, listening for voices about the house, a shattered ear drum could well result, because a loud crash always followed faint voices.

Several visits by the "faultie" resulted in N.I.A.s (nobody in attendance) until quite late one day, the door was opened by an elderly gentleman, who promised that the trouble would cease.

Further contact with the same gentleman after still further "perms" revealed that his even more elderly sister (who was not all that she used to be mentally) was in the habit of leaving the receiver off, then responding to the howler by standing well clear of the swinging hand converser, muttering, then striking it with the broom!

Just how do you cope with a fault like this?

★ ★ ★

The well-known adage, "the customer is always right" may not always be true, but on this occasion, after much doubting, the customer was right much to our embarrassment.

Several faults were reported on a new service by an elderly lady who complained that the new telephone "hurt her knees." These were treated in the obvious way by either the "complaints" operator or the test desk technician.

However, one day a real Sherlock Holmes was on the desk, and he arranged for a visit by the area technician. How embarrassing for him. A new man on subs. installation had only installed handsets before, and this was his first wall telephone. Yes, you guessed right, installed on the skirting board! The old lady's knees soon recovered.

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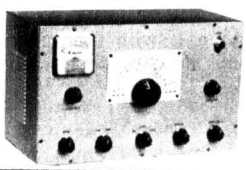
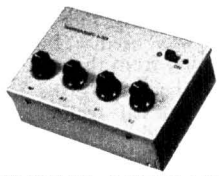
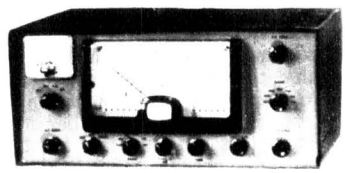
3-BAND DOUBLE CHANGE RECEIVER, MAY, 1966.





4-CHANNEL AUDIO-MIXER, FEB., 1966-1967.

5-BAND DSB TX, NOV., 1965



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12. Millivoltmeter (A.C.)
13. Transistorised Millivoltmeter (A.C.)
14. Noise Distortion Millivoltmeter
15. VTVM
16. 1966 VTVM 5% Resistors
17. 1966 VTVM 1% Resistors
18. 1966 VTVM Probes 6ALS Diode Probe

BRIDGES
19. R.C. Bridge
20. 1966 R.C. Bridge
21. 1968 R.C. Bridge and Signal Injector.

SIGNAL GENERATOR AND OSCILLATOR TV INSTRUMENTS
22. Sweep and Marker Generator
23. 5-5 and 36 MHZ Sweep Generator
24. Silicon Diode Noise Generator
25. Silicon Diode Sweep Generator
26. Pattern Generator
27. Pattern Generator Transistorised
28. Wide Range Pulse Generator

AUDIO INSTRUMENTS
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30. 1962 High Performance Audio Generator
31. Crystal Locked Standard
32. Electronic Tuning Standard (Less C.R.T.)
33. Transistorised Audio Oscillator (Inc. Square Wave and Meter Facilities)
34. Direct Reading A.F. Meter
35. Square Wave Generator (10HZ-1MHZ)
36. Transistor Audio Signal Generator
37. Additive Frequency Meter
38. Additive Frequency Meter (Less Crystals)
39. A.F. Tone Burst Generator

R. F. INSTRUMENTS
40. 6 Band service oscillator
41. Transistorised wave meter
42. G.D.O. Adaptor
43. Transistorised service oscillator
44. Simple Signal Injector
45. Wide Range G.D.O.
46. Transistorised Signal Tracer
47. Transistorised — Oscillator (Inc Crystal)
48. Basic Test Oscillator
49. Transistor Test Oscillator.
50. Signal Injector and R.C. Bridge

MISCELLANEOUS INSTRUMENT KITS
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52. Valve and Transistor Tester
53. Electronic Stethoscope
54. Moisture alarm
55. Electronic Pistol Range
56. Geiger Counter Transistor
57. Light Beam Relay Alarm.
58. Flasher Unit.
59. Transistor Alarm.
60. Electronic Switch.
61. Photo Timer.
62. Direct Reading Impedance Meter.
63. Electronic Anomometer.
64. S.W.R. Indicator.
65. Simple Proximity Relay Alarm.
66. Pipe and Wiring Locator
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73. Transistor Fully Protected Supply (Less Meters).
74. 1966 H.T. Regulated Supply—190-270V at 40 MA.
75. 1966 H.T. Regulated Supply (Less Meters).

VOLTAGE/CURRENT CONTROL UNITS
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79. 4KW Automatic Light Dimmer.
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81. Model Train Control Unit W/Simulated Inertia.
82. High Power Model Train Cotrol Uit with Simulated Inertia.

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87. 6 or 12 volt RO-FO Coil Kit.
88. (Special Ignition Coil.)
89. 6 or 12 volt Kit (Ignition Transformer Type).
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92. 40 Watt Unit (DC-DC) Converter Transistor.
93. 40 Watt Unit (DC-DC) Converter 12V Input.
94. 70 Watt Unit (DC-DC) Converter 12V Input.
95. 100 Watt Unit (DC-DC) Converter 12V Input.
96. 140 Watt Unit (DC-DC) Converter 24V Input.
97. 225 Watt Unit (DC-DC) Converter 24V Input.

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99. Mullard 3.3.
100. Mullard 5-10 Single Unit.
101. Mullard 5-10 Two Units.
102. Mullard 5-10 (Trans.).
103. Transistor — 20 Watt.
104. Transistor — 60 Watt.

STEREO UNITS
105. Mullard—2-2.
106. Mullard—3-3.
107. Mullard—10-10
108. Mullard—5-5 (Trans.).
109. Mullard—10-10 (Trans.)
110 Philips—Twin 10.
111. Wireless World 20-20 (Trans.).
112. HI-FI 60-60 (Trans.).
113. Playmaster Standard 2-2.
114. Playmaster Unit 3.
115. Playmaster Unit 4.
116. Playmaster Twin 10.
117. Playmaster 101 Basic Amplifier.
118. Playmaster 105 (Trans.).
119. Playmaster 113 (Trans.).
120. Playmaster 115 (Trans.).
121. Playmaster 118 Valve.

P.A. & GUITAR UNITS
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133. Playmaster 103 Guitar.
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CONTROL UNITS
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143. Playmaster 112 Stereo
144. Playmaster 120 Stereo
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148. Wireless World Systems — Stereo.

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151. Transistor Silicon Mono.
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158. Transistor—4 channel.
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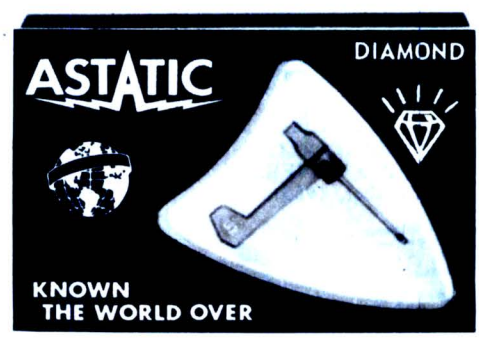

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AUDIO TOPICS

Television pictures from an LP record

For almost as long as one can remember, inventors and promoters have been speculating about the possibility of recording moving pictures on gramo. discs, along with the accompanying sound. A unit exhibited at the last Audio Engineering Society convention in the U.S.A. comes about as close to the objective as we are likely to get in the forseeable future.

Through the years, there have been reports that this firm or that firm were about to release "moving picture" records but, in fact, they have never materialised. Some of the reports have been triggered off by over-optimistic "inventors"; others have been initiated by non-technical writers who have failed to appreciate the essential difference between a series of still pictures and an effective continuous-motion presentation.

The basic problem is that recording systems — or transmission circuits — which provide a bandwidth economical and appropriate for audio information are substantially limited to an "audio" bandwidth, at most 20KHz. But, to record, transmit or reproduce reasonable quality, continuous - motion pictures electronically requires a bandwidth of at least 2MHz, a disparity of at least 100:1.

A tremendous amount of research has gone into "redundancy" and other techniques aimed at reducing the bandwidth necessary to cope electronically with moving pictures, but the techniques involved are both complex and costly. The alternatives are: (1) To reproduce enough pictures for continuous motion, but with unacceptably poor quality, or (2) To present pictures of good definition but at such a rate that they cannot sustain a visual impression of motion, being rather a sequence of "stills."

The last approach has been the one which has received most attention from pictures-on-record enthusiasts and is the one which has given rise to most of the over-optimistic or false reports referred to earlier. It is also the approach which forms the basis of the Phonovid system exhibited recently at the A.E.S. convention and developed, apparently, by Westinghouse engineers.

An excellent report on the system appears in "Audio" for June, 1968, by Edward Tatnall Canby. What follows is a slightly abbreviated version of Canby's remarks:

The reason Phonovid interested me was that its visible product is an L.P. record. Not a special one, but a very ordinary, completely standard, commercially pressable L.P. Ignoring the label, you couldn't tell it from a couple of billion others. It comes out of a standard pressing plant, cut with all the others on standard cutting heads, off standard recorded tapes. It plays on the usual good-quality L.P. playing equipment, without any special differentiation—ordinary motors, cartridges, styli. All quite routine.

But what "plays" from this L.P. record, with a bit of extra circuitry hooked into the system, is pictures. Plus a sound track, in sync.

Put the record on an ordinary L.P. player with this system, lower your ordinary stylus into the wholly standard groove, and you get a long, measured succession of still pictures in black and white on the face of a TV set connected to the system. Up to 400 "slides," to use the nearest conventional terminology, projected neatly one after another from the L.P. record with time to look at each one and listen to the accompanying sound.

And, you may hook in as many TV sets as you want. That might be quite a number if, say, you were a school system. Or a business with a host of audio-visual messages to get over to a great many people. Or a specialised training course, mass-production type.

In other words, here is a complete built-in lecture on an L.P. record — the lecture itself, the audible message, plus copious quantities of pictures, each one "frozen" on the screen long enough to look at, as the sound track does the describing. Good TV stills, too. I saw them on multiple rows of TV viewers down the sides of an auditorium. They seemed to me to be just as clean, just as steady and sharp and undistorted, as any normal black-and-white TV images you're likely to achieve on standard commercial sets, either broadcast or closed-circuit.

All this off a totally standard L.P.!

The actual recording system (I'll get to it) is not really the vital point. The L.P. record itself came first, and determined the parameters. Plus the standard TV screen. Anyone who knows TV and cathode-ray technology can figure out how you might derive pictures from a disc groove. Nothing revolutionary at all except, in Phonovid, the specific choice of working parameters. What matters, you see, is the medium.

The L.P. record is one of the simplest, the cheapest existing vehicle for mass-scale information that we now have. And it's available.

And the same with the associated TV. Standard stuff. Though TV isn't exactly cheap or inherently simple, it is also very definitely available. It exists. It is widespread and its presence is increasing everywhere, and most especially in the very places—schools, industrial training centres, sales meetings, etc.—where this Phonovid system might be most useful.

With standard equipment at either end, Phonovid is off to a flying start. All you need is the middle circuitry—the minimum that can be added to operate within the standard parameters at the two ends. That was the experimental project.

Ah, how about all those "limitations"? There are plenty, if you insist on looking at it that way. But in this sort of fun-and-games project you start at the far end and work backwards.

Phonovid is quite unlike, say C.B.S.'s new E.V.R. (Electronic Video Recording), which introduces its cannily designed new equipment to meet very different basic parameters—a maximum compactness of information content on a much more demanding scale, recorded TV in full motion and in colour. Phonovid's L.P. disc contains no TV motion. No colour. Just pictures. And sound.

As it has worked out, Phonovid projects slowly. Much too slowly for direct continuity. It gives you, as the L.P. record plays, a good TV picture every six seconds (though you may hook them together for longer shots. when desired). And so you see what we have. This is a system technically related to the close-spaced moon shots we all saw. Successive views, each a still picture, each advanced in "motion" over the previous one. But those were more rapidly projected. At a six-second spacing even that sort of semi-motion is out of the question.

Why stills only? To "move" a TV image you need a very wide bandwidth, as the videotape people know only too well. To get TV in motion on to tape you must resort to all sorts of inherently complex mechanisms providing in one way or another the high tape-to-head speed that is essential.

Your L.P. record has a hopelessly limited bandwidth from the moving TV viewpoint. But given a bit of time, you discover things aren't so bad. All you have to do is to scan your picture more slowly. Much more slowly. And store up the information as you go

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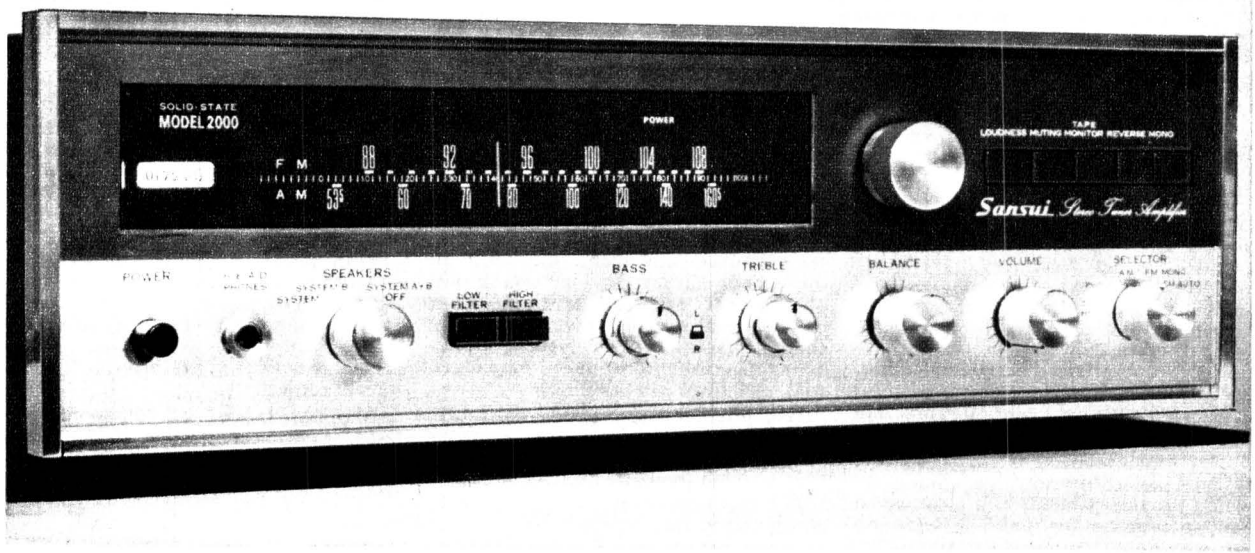

Twelve months from now you will have forgotton precisely how much you paid for your Sansui Amplifier. Price will have become irrelevant. The only important factor in your mind will be how satisfied you are — how glad you paid that little bit more for the first class workmanship that has been put into your Sansui.

On the other hand, if you bought something that was a "bargain" and maybe only bought it because it was cheap, you will most likely regret it for ages. Measure it this way: Over a ten year period of enjoyment and complete satisfaction with your amplifier, is it worth jeopardizing all this to save a few dollars?

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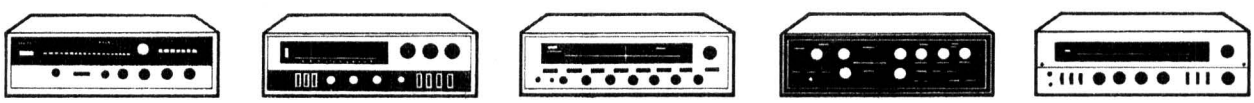

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along, until you want to use it. A memory device.

When each picture is complete, it is presented on the TV screen, all at once (as the eye sees it). Meanwhile, behind the electronic scene, another picture is being slowly drawn by the scanning beam, actuated by the record groove. Takes that full six seconds to do it.

How do you store up picture info.? Via one of those tricky memory-type storage tubes. Phonovid uses two tubes, one to collect the slow playback info. and the other to accept the complete fast-scanned image when the first tube is ready.

There's a slight degradation, I gather, as this transfer system operates. But it isn't of serious proportions. "No problem," the engineers said at the demo. And that's the way it looked to me. Surprisingly clear, steady pictures. Sharp enough to read print and diagrams of considerable complexity.

Let me be slightly more specific, as per the notes I took at the time. The basic nominal bandwidth for the picture is, if my handwriting is correct, 10KHz, operating via a reconstituted sideband, laid out from 5KHz upwards on the LP record. The sound track uses the lower portion of the spectrum. Not exactly hi-fi sound—but I found it a lot better than the usual dreadful sound track we hear via normal 16mm. sound film.

Actually (my notes say), the system goes a bit wider in practice, up as high as 18½KHz, giving a maximum bandwidth for the picture of some 13-plus KHz. That little extra probably helps. Given that much bandwidth, and the standard LP playing speed and playback equipment, you can come up with a good picture at the six-second rate.

The whole thing plays as long as a normal LP plays—which is a long time. Maximum is, perhaps, 30 minutes a side.

Now—for some urgent questions. What happens when you take the phono stylus out of the groove in midplay. Really zany! The last picture just stays on the screen.

When you put your stylus back in the groove, things start going again, though there may briefly be a split image, half of one picture and half of another. (Not more than the six seconds maximum, of course.) A very odd effect! You can stop anywhere and hold.

The sound track, of course, reacts exactly as on a normal LP record. The voice stops then starts in the middle of a word. But the picture "hangs over."

Now for the big one—how about mechanical distortions due to the record and stylus? What do you see when there is LP surface noise? Hiss, pops, cracks, clicks? And, even worse, what about wows, warps, ripples, off-centre grooving? There really ought to be unbearable degradation, yes? All sorts of snow, flashings, picture distortions, all the horrid TV "static" effects? An LP record, strictly mass produced, isn't that "clean." And, remember, no special treatment.

The engineers had this figured out from the word go. They thought ahead, and solved the problem. So ingenious. Frequency modulation. An FM signal on the disc, containing the picture info.

There are minor distortion effects, to be sure. But not as you might have expected. Some wobbly lines. And brightness may vary across the picture in extreme cases. But it takes a large amount of plain, blatant record wow to produce any serious distortion at all. Surface imperfections do not play back as they would in a straight "pitch for pitch" recording. FM treats them as static. Indeed, the system is quite astonishingly efficient, I'd say. It seems almost immune to distortion. The record plays its pictures as smooth as silk. And that is a very big favourable factor in potential mass-produced cheapness.

Why use disc at all—why not tape? Aha—back to the first premise. Tape is too limited in the sense of a mass-produced and widely-distributed medium. Tape, too, is clumsier and less convenient in a dozen crucial ways. All the old factors operate, those that have kept the disc alive and supreme all these years, in spite of tape.

But wouldn't tape produce a better picture? It could — of course. Given changed parameters. But since, via the frequency-modulated Phonovid system, most of the mechanical disc crudities are by-passed in the reproduction, the engineers say that within desirable parameters the LP record has no trouble equalling tape quality.

Finally, how about those over-all limitations? Motion is out as we know, and not even considered in Phonovid. But what of colour? Colour would be enormously helpful, in the very places where Phonovid might be most useful. Projected slides and film strips, after all, do provide colour as well as black and white.

Well, lots of things might be useful. Like optical sharpness equal to that of an optically projected picture. TV doesn't have it, in any shape.

You can't have everything. No system does. Better sound might be nice, but the Phonovid sound is already superior to most 16mm sound, and it is easily intelligible on speech, O.K. for background accompanying music, too. Stereo, in this situation, would be a frill, but not an important factor.

As for colour, it might be managed (the engineers suggested) by two channels of info; but they had not gone into this possibility. Cross talk on the stereo disc would present serious problems, they said, for one thing.

I'll have to admit that the lack of colour does seem to me the only really vital limitation in the Phonovid set-up. Here's where Sony's "magnetic" disc pulls ahead. The record-shaped video disc announced by Sony back in 1966 was reported to play colour still pictures on TV. In addition, the video disc can be recorded upon. This video concept requires an altogether different disc and playback/record machine, unlike the Phonovid.

Then there are video tape recorders. Why settle for "stills" when you can have motion pictures, in colour or black and white? It's just that these devices require, like the Sony video disc, a new basic machine, compared to the familiar record turntable and LP record. So let's wait and see if this particular project ever gets out of the labs and on to the turntable. I myself think that Phonovid has something, even in face of all the complex competition in the picture world, due to its mass-produced simplicity, plus the fact that I've already got a record turntable, am partial to using the medium of record discs, and own a TV set! ■

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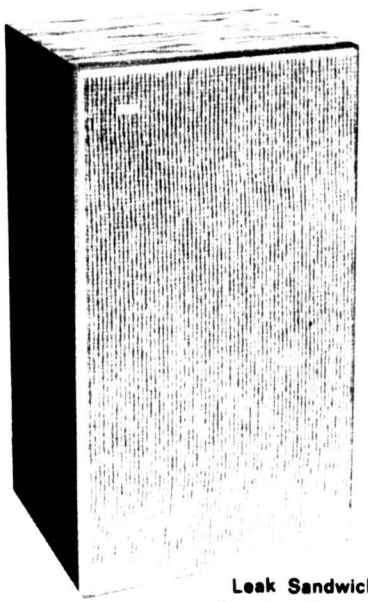

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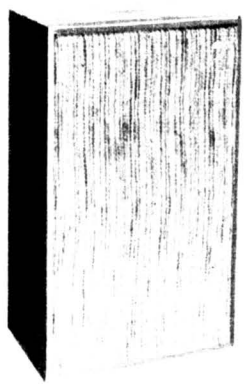

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NEW INSTRUMENT SIMPLIFIES ACOUSTIC MEASUREMENTS

Acoustic measurements that often took hours or even days to complete can now be performed in a matter of minutes with the help of a new audio range spectrum analyser announced by Hewlett-Packard.

Unlike other audio analysers, which measure signal frequency components one at a time, the new HP Model 8054A Real-Time Audio Spectrum Analyser looks at twenty-four 1/3-octave frequency bands simultaneously and writes out a spectrum in less than 30 milliseconds.

Here's how it works: there are 24 filters connected in parallel at the input. Each filter has a detector that determines the amplitude of signal components in that channel. An electronic switch sequentially samples the detector outputs in synchronism with a CRT sweep to derive a CRT display of amplitude vs frequency. The speed of scanning (1mS per channel) presents the data virtually in real time. A slower scanning rate is used to derive analog output voltages for an X-Y recorder.

A built-in analog-to-digital converter can be switched to any detector output to obtain a digital indication, which is supplied to a rear-panel connector and also to a built-in digital display. Sequential switching of the analog-to-digital converter to all channels may be performed automatically by a built-in scanner or in any order by remote control.

Front-panel pushbuttons select one channel at a time so the signal level in any frequency band can be read on the digital display with 0.1dB resolution. The CRT trace is brightened to show the location of the selected channel on the spectrum.

The data is thus available visually in engineering units (dB) or as a spectrum displayed on the CRT; it is available as analog voltages for tracing the spectrum on an X-Y recorder, and it is available as BCD digital information (level and channel identification) for digital recording or computer processing.

Because the analyser responds immediately to changes in the input signal, design adjustments affecting the signal can be evaluated without delay. The new analyser can also retain the spectra of impulsive sounds on display for analysis (capacitors at each detector output can be switched to capture a transient spectrum for repeated readout). Thus, one-shot phenomena can be analysed instantly without resort to recorded tape loops.

Of particular importance, the digital representation of level and channel identity can be fed directly to a computer, a digital recorder, a magnetic tape recorder, etc. The analyser itself has flat response, making it possible for a computer to apply any desired weighting factor to the data. Consequently, the analyser is not confined to any of the various methods proposed for sound analyses. A computer can also subtract background noise, make adjustments for the effiects of atmospheric humidity on sound transmission, and perform other manipulations to give the data in the desired form within an instant of the experiment.

Because of the real-time performance of the instrument and the digital output, it is possible to perform many experiments — like determining reverberation time as a function of time and frequency — in a fraction of the time formerly required. Since the analyser scans all channels repetitively, taking less than 30 milliseconds per scan, experiments with changing phenomena, such as analysing the sound of an aircraft flying, need be performed only once to obtain a complete set of data.

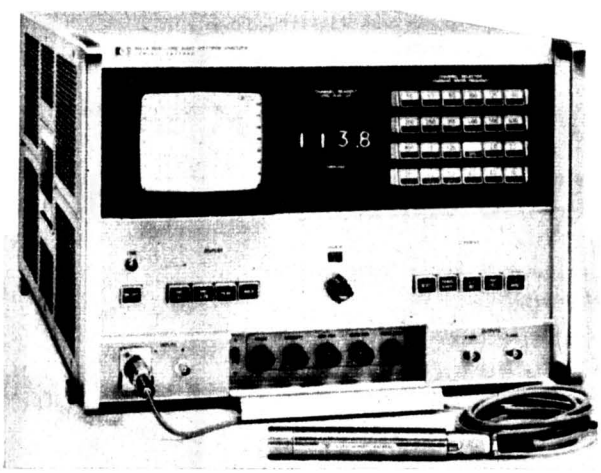
The new analyser's amplitude measurement range is 0 to 140dB with the 0dB reference at 1uV (a range of 1uV to 10V). When used with the companion Model 15109B Condenser Microphone, the 0dB reference is equated to 2 x 10 ubar sound pressure, approximately the normal threshold of hearing at 1KHz.

A logarithmic converter converts each filter-detector output into a voltage that is proportional linearly in dB to the measured amplitude. The digital readout is thus a logarithmic voltmeter displaying the amplitude in units of dB above 1uV (or above 2 x 10^4 ubar when using the HP 15109B Condenser Microphone) with an accuracy of ±1dB. The CRT display likewise is logarithmic on the vertical axis. The instrument's dynamic range is 40dB and a vertical bar on the right-hand border of the CRT shows the selected 40dB display range on a special graticule scale.

The frequency range is covered by twenty-four 1/3-octave filters with centre frequencies ranging from 50KHz to 10KHz. Other 8-octave filter sets with centre frequencies ranging to as low as 2Hz or as high at 16KHz can be supplied on special order. The 1/3-octave filter width is widely used for many acoustic measurements, such as those concerned with aircraft noise, underwater sound transmission, and noise analysis.

The instrument can present the RMS value of AC signals having crest factors up to 5 in each channel with a "fast" integrating time constant of about 0.1 second, which responds to rapidly changing signals. Or, the time constant can be made 1 second ("slow") to smooth fluctuating signals (other pairs of time constants between 100MS and 100S available on special order). The spectrum display at any instant can be retained for repeated readout when the HOLD pushbutton is pressed.

Peak values of transient or impulsive signals can be captured and retained when the PEAK bushbutton is depressed. In the PEAK mode, the display is updated any time that channel output amplitudes exceed those stored, but lower amplitudes have no effect on the display. Risetime of the detectors in the PEAK mode is 4MS.



The HP model 8054A spectrum analyser measures approximately 24 inches long, 12in high and 16in deep. It is constructed to withstand possible airborne and shipbeard use. Power consumption is 100W.

Amplitude range, display mode, and channel can be selected through a rear panel connector by simple contacts to ground or saturated NPN transistors. Thus, the analyser can be incorporated into a truly automated spectrum analysis system without modification.

The analyser can also be used with vibration pickups or other transducers for vibration analyses and for evaluation of the performance of gear trains and other sound producing mechanisms. It can also be used in the study of speech sounds for which its ability to retain a transient spectrum is of particular importance. In addition, the fast scanning rate delivers sufficient data for computer construction of 3-dimensional speech diagrams (amplitude, frequency, time). Another useful application is in the examinations of electrical signals in cataloguing signal "fingerprints" and other uses.

Further details of the instrument can be obtained from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria, 3146. ◘

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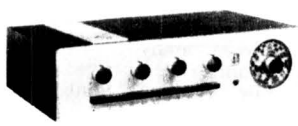

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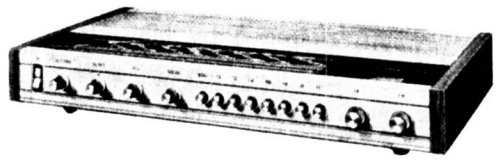

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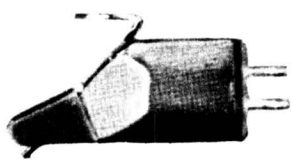

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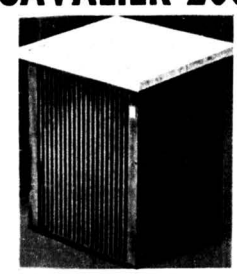

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Classical reviews

By JULIAN RUSSELL

Gabrielli Motets "wonderfully elating"

THE GLORY OF GABRIELLI. — Nine Motets for Multiple Choirs, Brass and Organ. E. Power Biggs (organ). The Gregg Smith Singers. The Texas Boys' Choir of Fort Worth. The Edward Tarr Brass Ensemble. Conducted by Vittorio Negri. CBS Stereo SBR-235259.

CBS went to enormous trouble to record these motets of Giovanni Gabrielli in St. Mark's Basilica, Venice, the church in which the sixteenth century composer spent most of his life as organist. They found the organ now installed in the basilica unsuitable for Gabrielli's baroque sound. It was much too big and full toned. They also thought the local choristers too tied to operatic conventions of a later period to be dissuaded from using these techniques in sixteenth century music. Then again the local brass players, while unmatched in performances of nineteenth century Italian opera, were unusable in the Gabrielli project.

So CBS set out to import into Italy the Gregg Smith Singers and the Texas Boys' Choir from America, brass players from Germany, an organ from Austria, and recording equipment from Switzerland. But they had not reckoned with what the record's producer, Jon McClure, describes in his entertaining sleeve notes as the "macaroni curtain" erected by the Italian Customs department, and the ecclesiastical authorities in St. Mark's. The Customs, after much cut and thrust and no little jiggerypook, were outwitted by the Americans who, under all kinds of skulduggery, managed to import the necessary instruments, players and performers.

But after having overcome this considerable hurdle they were faced with a Monsignor who refused to allow girl choristers into the church at night, when the recording sessions had to be held so as not to interfere with the tourist traffic in the daytime. He was outraged by the girl choristers' short skirts and make-up and even when assured that they were all virgins—though just how CBS established this interesting fact has not been disclosed—refused to allow them to enter the church until they had been supplied with long, neck-to-ankle white hospital gowns to wear there. As McClure writes, all that were missing were gauzy angels' wings.

Just why did CBS go to all this trouble? Primarily because the acoustics of St. Mark's are unique. There are several choir galleries that can be used simultaneously, a fact of considerable importance when the complex lay-out of the motets is remembered, since some of them are in as many 15 separate parts and rely on their effect on all being audible. Then again there is an echo, not quite so aggressive as the Albert Hall's in London, but nevertheless obvious enough to be characteristic. So it was to recapture the sound as it might have been heard in Gabrielli's day that the company went to such tremendous expense and trouble.

Were they successful? In my opinion, not entirely. For while they have recorded much exciting sound, the perspective of widely separated choral and instrumental units is not always as effectively recaptured as might have been hoped. Though the echo is there all right.

The music itself is wonderfully elating. Although Gabrielli wrote for the church there is more than a hint of earthly things in his triumphant music. He seems to be praising mundane rather than celestial things. The structure of the music is wonderfully clear, and the complex part writing can be followed without effort by a listener with reasonably good equipment. The record's title is an apt one, for here is glorious music, authoritatively performed and, except for the matter of perspective mentioned above, recorded with commendable fidelity. One is seldom lucky enough to hear liturgical music of such fiery energy and joyous acclamation.

★ ★ ★

MAHLER—Symphony No. 9. London Symphony Orchestra conducted by Georg Solti. Decca Stereo SET360/1.

Mahler wrote this symphony in a mood of fear and frustration after, at the age of 46, he learned from his doctor that he was suffering from an incurable heart condition. He survived for another four years only. Resentment at the finality of this verdict dominates the work. Now and again he makes a brief, almost hysterical affirmation of life, only to relapse again into despair. It is impossible to ignore the presence, or perhaps presentiment, of death throughout the symphony and Mahler's resentment at quitting life with his work still unfinished. What little there is of resignation soon turns to bitter hopelessness.

The symphony begins and end with slow movements. These are separated by two fast ones, a Scherzo and a Rondo Burlesque. The scherzo is full of fevered protests at his fate. Its savage sarcasm mocks at the life he is so soon to leave. Timpani suggest the thudding of a failing heart. Graveyard peals of bells remind one of the composer's mortality. And fear, too, is there in almost embarrassing reality.

The Rondo also jeers enviously at everything, light-hearted and ponderous alike. It is brilliant in its mockery, and the astringency of its writing made a direct appeal to such composers as Prokofieff who followed Mahler, and still influences Shostakovich. After this, Mahler faces up to reality in the Finale which is in a mood of resignation, its melancholy coloured with more than a little self-pity. A fitting end to a work of agonising self-examination.

Solti's interpretation exploits excitingly the composer's changes of mood, with the London Symphony Orchestra responding generously to a conductor they obviously like and respect. And it must be remembered that the LSO is a co-operative body whose committee decides on which conductor shall direct them in the works they have been engaged to record. The ensemble is magnificent, the first desk soloists just about peerless — where else would you find a horn player to match Tuckwell? — and the engineering superb. And when you reach the end of this doom-laden work you might well feel like Iago in "Othello," who, in his famous Credo in which he talks of death, finishes with "And after that there's nothing."

★ ★ ★

BACH — Xmas Oratorio. Elly Ameling (soprano); Helen Watts (contralto); Peter Pears (tenor and Evangelist); Tom Krause (bass). With the Lubecker Cantorei and Stuttgart Chamber Orchestra conducted by Karl Munchinger. Decca Stereo SET346/8.

Although I can recommend this recording with the greatest enthusiasm I must warn those to whom the oratorio is unfamiliar against trying to play it through at one sitting. Such was not the composer's intention and to do so will emphasise some unevenness in the inspiration. The oratorio is in six separate parts intended to be performed as follows: one for each of the three days at Christmas, one for the New Year, another on the following Sunday, and the last on Epiphany.

In my opinion—which is shared by most other critics and the Bach public alike the first two are far and away the best. Though this does not mean that there is not much to be enjoyed enormously in all the others. There has been one other complete recording in stereo of the Christmas Oratorio, the DGG which featured Richter with the Munich Bach Choir and Orchestra, and Janowitz, Ludwig, Wunderlich and Crass as soloists. It, too, is to be highly recommended but I think that, while you might prefer one of the soloists to another in comparing the DGG and Decca, the latter's engineering quality is superior to the earlier (1965) issue.

Peter Pears is a much acclaimed tenor and an undeniably intelligent one. But there is something in the timbre of his voice that I find far from alluring though his phrasing and interpretations are admittedly just about faultless. In this he sings attractively — except for an occasional squeezed top note — and with all his customary good taste and intelligence, but he is no match for Wunderlich who sang the Evangelist in the DGG set. Helen

Watts and Tom Krause I prefer to their opposite numbers in the older set; indeed they are so good, that they make Elly Ameling sound a little out of their class.

There is little to choose between the orchestral playing in both sets, but Decca makes better use of stereo in exploiting Bach's magnificent antiphonal writing. Another point in favour of Decca's orchestra is the oboist's use of what must be a slightly wider reed to re-create a truly seventeenth century flavour in the scoring. As to Munchinger's conducting, it is purposeful without undue hurry and the overall tone he produces has a brilliance that should illuminate the best Bach performances. Though, in contrast, the tenderness of the famous Pastoral Symphony — in both sets — is about as beguiling as it can be made to sound. All things considered, my final recommendation goes to the new issue.

★ ★ ★

SCHUBERT — Quintet in A Major (Trout).
Adagio and Rondo Concertante. Members of the Melos Ensemble. HMV Stereo OASD2328.

I suppose Schubert's "Trout" Quintet is just about the most popular piece of chamber music ever written, especially with the general public. But that fact does not make it any the less delectable to even the most sophisticated taste. That being so I think I can safely predict that his new recording is likely to win great acclaim from all sections of the music-loving community, for none other that I know combines all the good features of this E.M.I. performance. I don't think it necessary to go into details of a work whose many merits are so well known and well loved. But I can assure potential buyers that the playing by the Melos Ensemble is sinewy yet aptly mellifluous, and the balance perfect throughout. I don't have to point out to experienced readers that this last factor, when a piano must be blended in with a small group of strings, is of overriding importance. However it all comes off splendidly here with the excellent pianist, Lamar Crowson, though always audible, never intrusive. A world, too, of well earned praise, for the leader's beautiful contribution.

The sound is absolutely faithful, with a wide dynamic range that remains musical all the way from barely heard pianissimos to full-throated fortissimos. And its superb presence enables one to hear just how effortlessly these musicians achieve their effects, whether they are in long cantilena passages or others demanding the liveliest agility.

Then in addition to the best "Trout" I have ever heard there is a fill which will probably be new even to many Schubert scholars. The Andante and Rondo is in one movement, more like a movement of a piano concerto with string accompaniment than a piano quintet. (The double-bass from the "Trout" is used here to reinforce the cello part when necessary). It is an utterly delightful little piece, enchantingly played, and, importantly, has been added to the "Trout" without any tiresome shortening of the interval time between the different movements. For unalloyed enjoyment I can recommend the whole disc with the greatest enthusiasm.

VAUGHAN WILLIAMS—Symphony No. 6 in E Minor. The Lark Ascending (solo violin, Hugh Bean). New Philharmonia Orchestra conducted by Sir Adrian Boult. HMV Stereo OASD2329.

There was always a great affinity between Boult and Vaughan Williams. The latter valued the former's opinion highly during rehearsals of the first perfomances of his works, even to the extent of making slight changes in the scoring. And in matters of interpretation he was always satisfied to be advised by the conductor. There could have been no happier choice than Boult for this new recording of one of Vaughan Williams' greatest symphonies, the Sixth.

Although the first three movements are full of conflict and most of Williams' work was done on it towards the end and just after World War II, many people associate a war program with the symphony, much to Vaughan Williams' irritation. He constantly denied any such motivation though one is still tempted to believe that in the aftermath of that grisly struggle the composer could not have remained unaffected. His Fourth Symphony, written just before the war, dramatised all the composer's apprehension and fear of a forthcoming clash. The Fifth showed his hope for mankind's regeneration. And though we must accept Vaughan Williams' word that no warlike program was intended for the Sixth, it is difficult to disassociate such thoughts when hearing the work conducted as splendidly as you have it here.

The symphony has a big framework and the material is worked out with admirable logic. It is one of the last great symphonies in the old dialectical form to have been composed, if one excepts the works of the contemporary Russian composer, Shostakovich. Unusual in Vaughan Williams' music is the Mahlerian irony of the Scherzo, with a burlesque jazz tune in the Trio which, far from enlivening the movement, seems to add an extra touch of the sinister.

But it is in the unique Finale that Vaughan Williams is at his greatest. It is a whispered movement, with the dynamics never rising above pianissimo, its fragments of themes seeming to drift into the listener's hearing from outer space. Despite the superb security of its form, the music is curiously disembodied. I know of no other movement like it in all symphonic literature. Boult's reading — and the orchestra's playing — is all one could desire. And as a bonus you have the now famous "The Lark Ascending" with Hugh Bean playing the solo part with affectionate understanding and outstanding technical brilliance. ■

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DOCUMENTARY RECORDS

Reviewed by Glen Menzies

TALE SPINNERS FOR CHILDREN: "THE SWISS FAMILY ROBINSON," "THE PRINCE AND THE PAUPER," "THE CHARGE OF THE LIGHT BRIGADE," "THE LEGEND OF CUSTER'S LAST STAND." With the Hollywood Studio Orchestra. United Artists Mono TUA 66,509; 66,510; 66,464; 66,463. Released by Festival Records.

To quote a time-worn phrase, this is a very "mixed bag." I find it hard to believe that these are, in fact, modern performances. The adaptation is decidedly old fashioned, or is it that Hollywood producers don't really know much about children's tastes when it comes to story telling on record? The cover note assures us that the cast consists of "a fine theatrical company plus a famous actor or actress playing the title role;" if this is so they reveal no conspicuous talent for their work.

One of my main complaints about the handling of these stories is the punctuation throughout with hollow sounding orchestral music played by the Hollywood Studio Orchestra. The second side of "The Swiss Family Robinson" suffers very badly from this treatment; this quite fascinating story is skimmed through at high speed and the music is used to bridge the gaping holes left by the adaptor. The American accents grate on the ear and sound far more like back home in West Virginia than from Switzerland, and the acting is very stilted.

"The Prince and the Pauper" is better but I feel that this delightful story would have twice the impact in a more sensitive production by an English company, who would have a natural "feel" for the historical times in which it is set.

In a surprising preface to "The Charge of the Light Brigade" the narrator speaks of the uselessness and futility of the Crimean War, of the blot it made on the history of the nineteenth-century Europe and that the only redeeming feature was the heroism of the men of the Light Brigade. The note of scepticism is welcome, coming as it does from the place where so many Hollywood-style heroes are made. The actors in this production make a fair effort at assuming English accents, and the sound effects are used with some success to depict the battleground scene at Balaclava.

But what a magnificant opportunity was missed by not exploiting the wonderful possibilities offered by the intelligent use of stereophonic sound to indicate the ebb and flow of the battle. As it is we are only too aware of the aural limitations imposed by a single channel presentation.

Of "Custer's Last Stand," I can only say that this is a monumental bore in which every one, including the narrator, takes themselves far too seriously. My junior assistant, an eight-year-old, gave up half-way through the first side. There appeared to be such a lot of explaining to be done before the General made his last stand.

At their worst, these Tale Spinner presentations suffer from the same kind of drawbacks as much of the American material that is aimed at children on television — it just isn't good enough. The production of records for children should be given at least the same care and attention as goes into the making of a multi-track pop L.P. The quality of the pressings is excellent.

★ ★ ★

TEMPOS OF TIME: Narrated by the Rt. Hon. Lord Brabazon, with the Linden Singers and Sinfonia of London conducted by John Hollingsworth. A Fiona Bentley Production for The Children's Record Guild of Australia. E.P. 45 CG 26.

The technique here is to take a broad sweep through the years from 1900 to 1960, using music and voices. The voices of Marie Lloyd and Caruso are heard at the beginning, and the strange "bleep bleep" signal from a space satellite makes 1960 a good stopping place on the threshold of space exploration.

There is a whole kaleidoscope of sounds including the hoofbeats of a London cab horse, machine gun and cannon, marching feet, the voices of Hitler and Mussolini and an excerpt from a wartime speech by Sir Winston Churchill. It is not unlike the famous "Sounds of Time" by the B.B.C.'s John Snagge, but in miniature of course. The voice of Lord Brabazon does in fact remind us of B.B.C. programs in this vein, where the narrator brings a note of personal reminiscence to the presentation.

"Tempos of Time" is a record for older children with some knowledge of the history of the earlier years of this century. It is the kind of thing that comes across well on a record: in fact sound pictures like this have always been a valuable part of the recorded repertoire.

★ ★ ★

THE LIFE OF BEETHOVEN: With Robert Helpmann narrating, George and Hannah Pravda and Margaret Harmsworth (Piano). E. P. 45 CG 36. A Fiona Bentley Production for the Children's Record Guild of Australia.

This is another one in the Guild's "Appreciation of Music" series, designed to give young listeners a glimpse into the lives and music of some of the world's great composers.

The other two records in the series already reviewed on this page are "Mozart, Prince of Song" and "The Life of Chopin." They had a certain amount in common, both of them died young and they both played the piano at concerts in many of the great musical centres of Europe. Beethoven lived longer than either of these two composers but dominating his life were the early signs of deafness, which eventually became total. This aspect is given prominence here and relates to the incredible genius of the composer who, through all those silent years, wrote one great work after another.

The introduction of excerpts from the second, fifth, sixth and seventh symphonies, as well as the piano sonatas and other works, make a strong impact in underlining the quite individual sound of Beethoven's style of composition. I would only quibble over one detail. This is where the narrator speaks of the composer's anger in the Fifth Symphony. Surely this work is more the epitome of an indomitable spirit. It is among other things, a triumphant work: mere anger is transcended and becomes part of a larger vision.

Apart from this point, the musical excerpts are chosen with the same care as those on the earlier discs and they are expertly blended with the narration spoken by Sir Robert Helpmann with a clarity which helps to hold the attention of the young listener. George and Hannah Pravda act out small cameos from the composer's life and Margaret Harmsworth plays the excerpts from the sonatas.

Note for the grown-ups: after listening to this record with your children, you will probably feel a very strong urge to go out and add some Beethoven to your record collection. As in the case of others in this series, that is as good a recommendation as any. ■

KEF

Why not paper cones?

New industries begin where old ones leave off and long established skills help to establish many a new invention. When the growing loudspeaker industry demanded large quantities of lightweight moulded cones, it was the felted paper industry which provided an economical solution. That was over forty years ago and even today, the majority of speaker production is nurtured by this ancient craft. But the gentle skills of the specialist papermaker are dwindling in an industry which attracts few youngsters. The number of firms in all the world, which produce paper diaphragms, is very small and very little research is being done to improve the product.

Being a natural substance and hygroscopic at that, paper is scarcely an engineer's material. Its properties vary from batch to batch and the characteristics of diaphragms made from it differ widely and change with time, temperature and humidity. Nevertheless, with care and selection and with perhaps a touch of damping treatment in the right places, it is possible to obtain a very fine performance. But such a technique is scarcely admissible in a field of endeavour, which demands always better standards, tighter tolerances and greater reliability.

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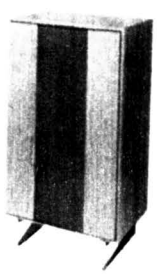
Paper cones will, of course, be around for a long time to come, especially for cheaper and less critical applications, but wherever precise reproduction is called for, more modern materials will be in growing evidence and KEF already have seven years' experience in this new field of development.



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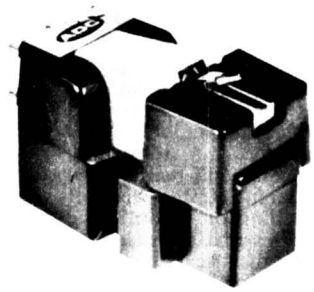

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VARIETY FARE

Reviews by: Neville Williams Harry Tyrer
T. Forbes Cameron

Devotional

EVERYBODY SINGS. Cliff Barrows and the Gang. Stereo, Word (Gospel Film Ministry) WST-83837—LP.

Interest: Gospel chorus singalong.
Performance: Keen.
Quality First rate.
Stereo: Nicely spread.

Though the name of Billy Graham has been used to identify the world-wide Gospel crusades, the musical side of the rallies is synonymous with the name of Cliff Barrows, a young man with a great deal of poise, a great deal of musicianship and an easy, relaxed style on the rostrum.

Just how much he is at home with young people is illustrated by this new singalong album, made with the College Chorale of the First Baptist Church of Van Nuys, California, associated with a choral group under John Gustafson

In the fourteen tracks is a medley of some two dozen of the Gospel songs and choruses which are currently being sung in evangelical rallies throughout the English-speaking world. Some of the "older" ones are there: A New Song In My Heart — Life Is A Symphony — Burdens Are Lifted; but there are a lot of the newer ones; The Numbers Song — The Restless Ones, Theme — He's Everything To Me—and a lot more.

Rhythm is well to the fore as one might expect of choruses favoured by the younger generation, but these tunes are also highly melodic, well arranged and very well sung. Every now and again, Cliff Barrows chimes in with an invitation for the listeners to sing right along with the group.

This is a record that I can highly recommend for all ages. I'll be very surprised if it isn't played more than any other devotional record you've bought in many a long year. (W.N.W.)

★ ★ ★

THIS IS MY FATHER'S WORLD. Tedd Smith, piano; Don Hustad organ. Stereo, Word (Gospel Film Ministry) WST8359-LP.

Interest: Campaign instrumentalists.
Performance: Capable musicians.
Quality: Normal.
Stereo: Overdone on piano.

Tedd Smith and Don Hustad are well known for their association with the Billy Graham crusades and this piano-organ duet album will have an automatic appeal for the many who have followed the crusades locally, and on TV and radio.

The performance caters primarily for popular taste, with Don Hustad playing on what is essentially a large cinema-style organ and Tedd Smith exploiting to the full variations on well-known Gospel themes. While this basic formula certainly has plenty of appeal in a rally atmosphere, it somehow struck me here as being overdone, with both musicians so intent on achieving an effect that the theme is quite lost sight of. There is nothing very majestic about the opening theme, "Who Is On The Lord's Side" while Tedd Smith's solo "I Surrender All" is notable, not for an appropriate quietness and humility but for a dazzling display of digital dexterity.

Other numbers include: Ivory Palaces—The Ninety And Nine—Behold A Host—I Walked Today Where Jesus Walked — Revive Us Again — We Gather Together — The Old Rugged Cross — He Whispered, "Peace, Be Still"—This Is My Father's World—Day Is Dying In The West.

If I seem to have been unkind to two very well known and very dedicated musicians, it is possibly because I personally prefer variations in lesser measure than they provide here. If you like it as is, then you won't be disappointed. The quality is O.K., by the way, but the surface has a few "prickles." (W.N.W.)

Instrumental, Vocal & Humour

TCHAIKOWSKY: Orchestral works performed by the London Philharmonic Orchestra conducted by Sir Adrian Boult. World Record Club Mono S-4417. Available in stereo.

Interest: Popular classics.
Performance: Full of charm.
Quality: Excellent standard.

The qualities which I usually attribute to a performance conducted by Sir Adrian Boult are an all pervading charm coupled with a slightly old-fashioned air. These are entirely admirable qualities which I personally find completely bearable and I cannot recall hearing a Boult performance which I have not enjoyed immensely. The qualities mentioned are present in full measure in this very listenable performance of three of Tchaikowsky's most popular shorter orchestral works — Romeo and Juliet Fantasy Overture—The Year 1812 Overture — Marche Slave. There are numerous performances of these works in the record catalogues, and I do not doubt that one can find some with wider dynamics in the more rumbustious sections of all three works, but in the lyrical quieter passages (particularly the lovers' theme in Romeo and Juliet) Boult takes some beating.

The technical side of this disc is well up to the usual high standard of World Record Club discs. Unfortunately, I was not able to secure a stereo version for review purposes, and I imagine a good stereo spread will considerable enhance the effect, especially in the "1812." (H.A.T.)

★ ★ ★

ORPHEUS IN THE UNDERWORLD and other favourite overtures. The New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR-235263.

Interest: Popular overtures.
Performance: Delightful.
Quality: Excellent.
Stereo: Normal.

Continuing his series of recordings of popular light classics, Leonard Bernstein here presents six overtures, each of which could wear the label "very popular": Orpheus in the Underworld (Offenbach)—Donna Diana (Reznicek)—Barber of Seville (Rossini) — The Beautiful Galatea (Suppe) — Merry Wives of Windsor (Nikolai) — The Light Cavalry (Suppe). This collection of light-hearted pieces is treated accordingly by the orchestra and it is noticeable that Bernstein is in relaxed

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mood, and gives the orchestra its head much more than is his custom most of the time. However, the master hand is firmly on the reins in the "Barber" overture, where the crescendos need careful control and the phrasing needs to be carefully shaped; also in "The Light Cavalry" to prevent the cantering tune from developing into a charge. A thoroughly enjoyable performance of these lightweight pieces, which one seldom hears played as well as in this performance. (H.A.T.)

★ ★ ★

CURTAIN CALLS. The Pittsburg Symphony Orchestra conducted by William Steinberg, Universal Record Club Stereo U-904.

Interest: Varied orchestral works.
Performance: Entirely satisfactory.
Quality: Excellent.
Stereo: Well spread.

The most important work in this selection of shorter orchestral pieces is Ravel's "Valse Noble et Sentimentale." This fine work has been unaccountably neglected for years by recording companies — it is not, by the way, to be confused with the much better known and often played "La Valse" — and it is presumably the hunger of record companies for new material which is responsible for its appearance here. There are eight waltzes in the suite, which are in varying moods and styles, and I would class them as typical Ravel in both thematic content and harmonic treatment.

About equal in length is Dvorak's "Scherzo Capriccio." Like the Ravel work, this piece is seldom played, but the neglect is perhaps rather more merited since, although it contains some beautiful melodies, these are surrounded by tedious passages of orchestral padding. The remainder of the program consists of six short and very well known pieces: Rakoczi March (Berlioz) — Petit Mari, Petite Femme and Le Bal (Galop) from "Jeux d'Enfants" (Bizet)—French Military March (Saint Saens) — Perpetuum Mobile and Tritsch Tratsch Polka (J. Strauss, jun.). On the whole, a very pleasing program, combining familiar and unfamiliar pieces in a variety of styles. The playing of the Pittsburg orchestra is of excellent standard throughout, and the recording quality is first class, with very wide dynamic range and negligible distortion. (H.A.T.)

★ ★ ★

NIGHTS AT THE BALLET. Various orchestras conducted by Robert Irving. Encore (E.M.I.) Stereo SOEX 9400.

Interest: Ballet excerpts.
Performance: Pleasantly schmaltzy.
Quality: Dated, but acceptable.
Stereo: Limited spread.

On recent experience I have come to regard many of the economy bargain discs being released of late with some suspicion, but I have no such reservations about this disc. In the first place, I know the performance of "Sylphides" and "Carnival" which makes up the larger part of the two sides very well, having had it in my collection for several years, and I attest to its durability by its frequent visits to my turntable. Apart from this, the playing time is very generous indeed, since in addition to the two works mentioned above there are generous additions in the shape of the Pas de Deux from "The Nutcracker" ballet and extracts from "The Sleeping Beauty" ballets of Tchaikowsky; and a largish segment of the "Giselle" ballet of Adam. Although the sound is dated, it is still of acceptable standard. Recommended for bargain hunters. (H.A.T.)

SOUND EFFECTS

EMI have recently released twelve sound effects records especially intended for use by amateur film makers and tape recordists. Manufactured in England and imported by EMI Australia, the records are 7-inch 45rpm E.P.'s, with a total playing time of from 5 to 12 minutes, depending on the subject.

The following is a list of the records, with their numbers:

Cross-Channel Ferry EFX.101; Aeroplanes EFX.102; Diesel Trains EFX.103; Steam Trains EFX.104; Electric Trains EFX.105; Cars EFX.-106; Wedding EFX.107; Seaside EFX.108; Weather Effects EFX.109; Clocks EFX.111; Birds EFX.113; Domestic Animals EFX.115.

For review purposes, we received "The Seaside" and "Cars." The first contains tracks with waves breaking, first associated with the sound of seagulls, then with children's voices and the faint sound of a distant band. On the second side is heavy sea and wind, light waves, wind and rain on the beach and water splashing around rocks.

The "Cars" recording contains the sound of a car arriving, a car turning, a car pulling away and of one passing. There is the sound of a horn, a journey inside a vehicle, clashing gears and a motor ticking over that reminded me rather strongly of the quality of vehicle I had to drive as a youth!

Technically, there is nothing startling about the discs but they are adequate for the intended purpose. (W.N.W.)

★ ★ ★

CONTEMPORARY ENGLISH MUSIC. The London Philharmonic Orchestra conducted by John Snashall. Virtuoso Series (Astor) Stereo SPLP1235.

Interest: As per title.
Performance: Polished.
Quality: Good sound, some tape noise.
Stereo: Normal.

Three works are presented: Symphony Elegy) 1965, Op. 40, by John McCabe—Concerto for String Orchestra, Op. 39, by Kenneth Leighton — Divertimento for String Orchestra, Op. 43, by Adrian Cruft.

The McCabe work has qualities which should appeal to those who have a taste for contemporary music without the aggressive avant garde features which many find hard to digest. Original and imaginative, it is lightly scored for the most part and the thematic material is pleasing. Here is a modern composer who is not ashamed to write a tune. I did find, however, that I experienced a sense of irritation in a few places from excessive repetition of short phrases.

Leighton's Concerto has some impressive sounding orchestral effects and broad sweeping phrases but is almost entirely lacking in anything resembling a recognisable melody. Just before the end of the last movement, something which could be construed as a coherent tune makes a brief, apologetic appearance but for most of the time the orchestra appears to be taking part in a shouting competition. The result —to me, anyway — resembles the noise of a crowd with everybody talking at once — a babel of noise, with no distinguishing features.

In complete contrast is Cruft's Divertimento, which is transparently scored and melodious in character. Although the thematic material is taut and angular in the first movement, it broadens in the second movement to something resembling the great pastoral tunes of Vaughn Williams. The third movement is a particularly fine piece of string writing. Space does not permit more detailed analysis of these works, but the excellent sleeve

note by Gerald Larner will be found valuable by purchasers of this interesting disc. Sound quality is of good standard, but there is noticeable tape noise in quiet passages. (H.A.T.)

★ ★ ★

VIENNA, CITY OF DREAMS. Andre Kostelanetz and his orchestra. CBS Stereo SBP 233517.

Interest: Viennese potpourri.
Performance: Polished.
Quality: Excellent.
Stereo: Normal.

The well-disciplined orchestra of Andre Kostelanetz gives its usual polished performance in this mixed bag of Viennese music. The program comprises: Waltz from "The Merry Widow" (Lehar)—Schoen Rosmarin (Kreisler)—Tritsch Tratsch Polka (Strauss)—Sag' Ja, Mein Lieb, Sag' Ja from "Countess Maritza (Kalman) — Czardas from "Merry Widow" (Lehar) —Serenade (Haydn)—Waltz from "The Count of Luxemburg" (Lehar) — Vienna, My City of Dreams (Sieczynski) — Perpetual Motion (Strauss) — Liebesleid (Kreisler) — Blue Danube Waltz (Strauss) — Loves Roundelay (Oscar Straus).

Sarame Endich, a very accomplished soprano, sings the vocal parts in the arias, while violinist Carrol Glenn demonstrates considerable skill in the solo violin parts of the two Kreisler numbers. With its 40 minutes of sheer melody, this disc makes very pleasant listening. (H.A.T.)

★ ★ ★

PETE FOUNTAIN PLAYS BERT KAEMPFERT. Coral (Festival). Stereo SCL932788 (also in mono).
FOR THE FIRST TIME — Brenda Lee and Pete Fountain. Festival. Stereo SDL932877 (also in mono).

Interest: Very commercial Pete Fountain.
Performance: Neither album impresses.
Quality: Both superbly recorded.
Stereo: Good balance and separation.

Leaving aside my personal view that Pete Fountain is one of the most overrated musicians in the business, I am bound to say that neither of these albums displays the clarinet playing of Fountain at its best.

The Coral L.P. was recorded in Europe with musicians from the Bert Kaempfert Orchestra and Fountain strolls rather glibly through 11 of Kaempfert's best-known compositions. They include "Strangers In The Night," "Danke-Schoen," "A Swingin' Safari," "Spanish Eyes" and "Love."

The arrangements by Herbert Rehbein are unobtrusive, but Fountain sounds surprisingly ill at ease on several of the tracks. Perhaps, like me, he felt that the Kaempfert Orchestra had already covered this ground more than adequately on their numerous, highly successful albums.

The combination of Pete Fountain and Brenda Lee is, on paper, a strange one, but it appears from the sleeve note that Fountain and she have had "a mutual admiration society" for some years.

Whatever the background, the album is not a devastating success. Miss Lee has some amazing mannerisms in her singing—a harshness and masculinity, and a tendency to over-project which

begins to grate a little. Her pitching is also suspect.

Nevertheless, Fountain himself seems to be a little more confident in his solos and obbligatos to Brenda Lee's vocals. The titles include "Cabaret," "Basin Street Blues," "Mood Indigo," "I Gotta Right To Sing The Blues" and "Can't Take My Eyes Off You." The arrangements by Charles Bud Dant are impressive.

It would be unfair to recommend either of these mediocre albums even to Pete Fountain devotees. For one thing, it depends very much on their reaction to Brenda Lee's singing. The playing time of the Kaempfert album is short at 28 minutes, while the album with Brenda Lee plays for 34 minutes. (T.F.C.)

★ ★ ★

ENOCH LIGHT PRESENTS TWENTY-ONE TROMBONES — Urbie Green. Project 3 (Festival) Stereo SPJL-932775 (also in mono).

Interest: Not just for trombonists.
Performance: Surprisingly successful.
Quality: Excellent recording.
Stereo: Good separation and balance.

At first, the thought of no less than twenty-one trombonists playing together is a little daunting. But, in fact, the 34 minutes of this album turn out surprisingly well.

There is no doubt about the professionalism of the trombonists involved. The album features the superb solo work of Urbie Green, who made his reputation with Woody Herman in 1950-52 and was subsequently associated with Benny Goodman in the late 1950s. Since then, he has been very active as a New York session musician. Some of the other trombonists include famous names like J. J. Johnson, Lou McGarity, Will Bradley and Kai Winding.

Thoughtful arrangements by Lew Davis create a surprising amount of tonal variety, with the trombones at times cascading behind Green, at times taking the melody with a lovely, rich sound. Guitar solos by Tony Mattola and Barry Galbraith also help to sustain interest.

The best tracks on this recommended album are, I think, the ballads like "Here's That Rainy Day," "Stardust," and "Without A Song," which are particularly suited to the warmth of the trombone. (T.F.C.)

★ ★ ★

ABOVE THE STARS — Acker Bilk with the Leon Young String Chorale. Columbia Encore Series (E.M.I.). Mono OEX9381.

Interest: Pleasant relaxing music.
Performance: Not quite the best Bilk-with-strings.
Quality: Well recorded.

Most readers of this review will have heard, at some stage, tracks by the highly successful combination of Acker Bilk's clarinet and the Leon Young String Chorale. Personally, I rather enjoy their albums in small doses.

However, the really important ingredients in an album of this kind are tunes of a high melodic quality. Unfortunately, some of the selections on this L.P. are not quite strong enough to sustain interest.

Nevertheless tracks like "Moonlight Becomes You," "Skye Boat Song," the late Ziggy Elman's famous "And The Angels Sing" and Charles Chaplin's beautiful "Limelight" come off very well indeed. As usual Bilk plays very pleasant, reedy clarinet and Leon Young's arrangements for his String Chorale are immaculate.

The fact that E.M.I. have issued this on their budget-price "Encore" Series may possibly be enough to offset the few less impressive tracks on the album. The playing time is 35 minutes (T.F.C.)

★ ★ ★

GOLDEN TROMBONE FAVORITES —Warren Covington and his Orchestra. Calendar (Festival) Stereo SR66-9419 (also in mono).

Interest: Big Band tribute to famous trombonists.
Performance: Rather ordinary.
Quality: Dull, flat recording.
Stereo: Adds very little.

Trombonist Warren Covington directed the Tommy Dorsey Band following Dorsey's death in 1956, and since 1961 he has led the remnants of that Orchestra under his own name.

Like the new Glenn Miller Orchestra, the appeal of his band is based on nostalgia for the famous Swing Bands of the late 1930s and early 1940s; and, in essence, the music has changed very little.

The tracks on this album are all associated with famous trombonists Some are bandleaders like Tommy Dorsey ("I'll Never Smile Again") and Si Zentner ("Lazy River"); while the others are famous soloists like Bill Harris of the Woody Herman Band ("Bijou"), Trummy Young ("Margie") and Jack Teagarden ("I Gotta Right To Sing The Blues").

But recreations and musical tributes of this kind rarely result in satisfactory albums and the tracks on this L.P. have a dated and rather uninspiring sound. The Warren Covington Orchestra is competent enough musically, but the arrangements show little enterprise.

All in all, this is a dull album and the playing time is mercifully on the short side at 34 minutes. (T.F.C)

★ ★ ★

GOLDEN HAWAIIAN HITS, Martin Denny. Stereo, Liberty (Festival) SLYL-932,665. Also in mono LYL-32,665.

Interest: Denny's Hawaii.
Performance: Sparkling.
Quality: Very clean.
Stereo: Plenty of spread.

Ever since his first "Exotica" album for Liberty Records, Martin Denny has been identified with a characteristic sound — bright, tuneful, rhythmic, simple yet always interesting. Here the Denny treatment is applied to the kind of Hawaiian music with which he is so much at home. Hawaiian Village —Sweetheart Aloha — Diamond Head — Lovely Hula Hands — On The Beach At Waikiki— Little Grass Shack — Pagan Love Song — Aloha Oe, and many others: to be precise, 20 in all.

Good for background, good for straight listening. (W.N.W.)

★ ★ ★

THE DOWNTOWN SCENE—Ninapinta and his Bongos and Congas. Calendar (Festival). Stereo SR66-9423 (also in mono).

Interest: Good party music.
Performance: Preferably in small doses.
Quality: Good bright recording.
Stereo: Makes little difference.

I have no idea who or what Ninapinta and his Bongos and Congas are, but my guess is that the musicians on the album are New York session men.

The band is medium-sized with two trumpets, two or three reeds plus a rhythm section including several first-rate percussionists.

The tunes ("Hits for the Hip") are

a bit dated now — "Help," "Downtown," "Lovers' Concerto," "Satisfaction" and eight others like those — but the musicianship is of a reasonably high quality. The arrangements, however, are somewhat unimaginative and little attempt is made to vary the sound of the group.

This is really ideal party music—loud, brassy and lacking in dynamics. For listening, 36 minutes of this kind of music becomes a shade monotonous but it is punchy and swinging in its own rather unsubtle fashion. (T.F.C.)

★ ★ ★

HUMPHREY BISHOP PRESENTS: 60 Years of Song. Mono, RCA L-101,812.

Interest: Radio, pre TV.
Performance: Vital.
Quality: Acceptable.

What memories this record stirred. The construction of what was, in its day, the showpiece radio studio in Sydney; the multiple control rooms, recording annexe, sponsor's gallery, the battery of RCA ribbon mikes, twin grand pianos and a concert Hammond — one of the first of such organs in Australia. And, of course, Humphrey Bishop with the chorus, orchestra and guest stars who pulled high ratings with their live presentation of evergreens before an eager studio audience.

Selected from recordings of the show made between 1941 and 1945, this album features Walter Kingsley, Magda Neeld, Albert Miller, Marie Burke, Willa Hokin, Alan Eddy, Strella Wilson, Norma Beattie and Joe Barnes.

The numbers: Without A Song — I'm In Love With Vienna — One Day When We Were Young — Smoke Gets In Your Eyes — Someday I'll Find You — Farewell To Dreams — Could I Be In Love — The Gendarmes' Duet — A Room With A View — I Got Plenty Of Nuttin' — The Blue Room — The Donkey Serenade — Ol' Man River.

The performances are consistently good and the soloists well recorded, and anyone who can recall those days will thoroughly enjoy this presentation. You may note, however, that the orchestra and chorus are quite muffled and it isn't hard to appreciate the trend, which later became evident, to plan studios and microphone layouts for a brighter, more reverberant sound. (W.N.W.).

★ ★ ★

FAMILY PORTRAIT — 16 A&M artists A&M Records (Festival). Stereo SAML92/11 (also in mono)

Interest: Cross-section of popular music.
Performance: Very mixed.
Quality: Acceptable.
Stereo: Good separation on most tracks.

I daresay the idea behind this album will appeal to some record buyers. Festival have packaged tracks by 16 different A&M artists and issued the result at the reduced price of $3.95 (playing time, 43 minutes).

One obvious problem for potential purchasers with extensive record collections will be the likelihood of duplication. But a more serious criticism is the general impression of mediocrity throughout the album. I think it is fair to say that most of the tracks on "Family Portrait" were far from being the outstanding ones on the

original albums from which they were taken. Some tracks, indeed, are rank bad.

The artists range from Herb Alpert and the Baja Marimba Band to the late Wes Montgomery and Herbie Mann; from Chris Montez and Liza Minelli to Burt Bacharach and Antonio Carlos Jobim. I cannot imagine anyone enjoying all 16 tracks but, as an A&M sampler, it may have some appeal — especially at the reduced price. (T.F.C.)

★ ★ ★

ROMOLA COSTANTINO. Recital of French Piano Music. E.M.I. Stereo OASD 7545.

Interest: Sydney pianist.
Performance: Rather gloomy.
Quality: Good, but low level.
Stereo: Not significant.

Romola Costantino is one of Sydney's leading pianists, and I believe that she has made at least one earlier recording. E.M.I. is to be congratulated in affording these young artists recognition in the local recording sphere. Having said that it is with a tinge of regret that I have to express some reservations about this disc.

Miss Costantino shows considerable ability in her performance here but, on the whole, the disc proved to be something of a disappointment. The choice of pieces is curious, the program comprising: La Valse (Ravel)—Pavane for a Dead Infanta (Ravel) — Suite Bergamasque (Debussy)—Nell (Faure) — Pavane (Faure). Four of the five pieces are transcriptions for piano, only the Debussy being originally written for the instrument. All the works are introspective in character, and the result is a generally gloomy air in the performance as a whole which is not entirely dissipated even in the lively "Passepied" section of the Debussy suite. The "Claire de Lune" is taken rather fast, and in the process loses some of the air of mystery upon which this piece depends for its effect. Deprived of this, it becomes a rather trite little tune. On the credit side, "La Valse" spins along with a nice air of irony, and I found this the best part of the disc.

Sound quality is of good standard, but is recorded at rather low level, so that one is forced to turn up the wick to the extent that surface noise is amplified more than is good for listening. (H.A.T.).

★ ★ ★

GEORGE FEYER. Piano Magic: Hollywood. Stereo, Calendar SR66-9,488. Also in mono R66-488.

GEORGE FEYER. Echoes Of Love. 26 Great Love Songs. Stereo, Universal Record Club SU-900. Also in mono U-900.

Interest: Melodic piano.
Performance: Smooth, pleasant.
Stereo: Not vitally important.
Quality: Very clean.

Of all the pianist-entertainers available on record, I doubt that any has a more relaxed style or is easier on the ear than George Feyer, and both these budget-priced records demonstrate the point.

The first is done with rhythm backing and features Hollywood themes: Mary Poppins Medley — The Sweetheart Tree — Moon River — Forget Tomorrow — Charade — Zorba The Greek — It Had Better Be Tonight — The Sandpiper Theme — Ship Of Fools — Dear Heart — Days Of Wine And Roses — Goldfinger. All these are separate tracks and will appeal to those with an ear for the more recent movie soundtracks.

My pick, however, is the second record "Echoes Of Love," mainly because it fits the way I personally like to listen to George Feyer, solo piano (or nearly so), a completely unbroken flow of melodic variations, and tunes that date back just a little further: Mood For Love — Many Splendoured Thing — Parlez-Moi D'Amour — They Say It's Wonderful—The Girl That I Marry — and lots of others.

As a background for dining or relaxing, these albums would be hard to beat. (W.N.W.)

★ ★ ★

NERO-ING IN ON THE HITS. Peter Nero, piano, with orchestra. RCA Dynagroove Stereo LSP-3871. Available in mono.

Interest: Recent hit tunes.
Performance: Skilful, but . . .
Quality: Usual Dynagroove excellence.
Stereo: Ditto.

I must admit that I do not quite know what to make of Peter Nero. His tremendous talent is unquestionable. He is an imaginative arranger, skilful pianist and composer, and I obtained a great deal of pleasure from his early discs. Yet somehow his latest releases do not quite click. After careful consideration, I put this down to two things — firstly, his choice of material and secondly his rapid changes of style at the piano.

This latest release forms the perfect example of this. The songs are mainly those which have occupied high positions in the popularity charts but are now no longer in evidence: Up-Up and Away — Casino Royale — A Whiter Shade of Pale — The Impossible Dream — Ding Dong! The Witch is Dead — Fiddler on the Roof — Somethin' Stupid — Music to Watch Girls By — The Flower Children — Nero-ing In.

In his treatment of these, Peter Nero adopts a straightforward "cocktail piano" style for some of the time, but tends to rush off here and there into a kind of progressive jazz treatment. I do not wish to give the impression that the disc is not pleasant to listen to — quite the reverse. There are some enjoyable tracks — "Fiddler on the Roof" and 'The Flower Children" are particularly good, but I feel that this is a disc which you should try to hear for yourself. You may find it great, or you may not. It depends on your own taste. (H.A.T.)

★ ★ ★

ENTER LAUGHING. Gita Rivera, vocalist, with orchestra conducted by Thomas Tycho. RCA stereo SL101817. Available in mono.

Interest: Local talent.
Performance: Worth hearing.
Quality: Very good.
Stereo: Normal.

Although not yet 21, Gita Rivera has already carved the foundations for a successful career in show business, with numerous television appearances, a part in the film "They're a Weird Mob" and appearances in many nightclubs, cabarets and theatres. In this,

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Speakers	**SP-200** 40W 3-way, 5-speakers.	**SP-50** 25W 2-way, 2-speakers.	**SP-30** 20W 2-way, 2-speakers.

SANSUI ELECTRIC CO., LTD. 14-1 2-chome, Izumi, Suginami-ku, Tokyo, Japan

her debut record, she shows an impressive talent. She appears to have modelled her singing on that of Caterina Valente and like that great star, she is multilingual. In this album she sings in French, Italian and Spanish as well as in English. Apart from some slight lapses in phrasing here and there, her singing compares very favourably with that of Valente. She has plenty of time to improve, and I am sure we can expect to hear much more of this talented singer in the future.

Her program here comprises: Siboney — Two For The Road — Letters — La Vie en Rose — Spring— If He Walked Into My Life — Enter Laughing — The Streets Are Deserted Now — The Sweetheart Tree — Just Once More — Mama — My Heart Just Died. The technical quality of this local recording is excellent, the only slight cause for complaint I have being the over-prominence of the brass in some tracks, which gives the singer too much competition. (H.A.T.)

★ ★ ★

ALWAYS. Deanna Durbin. Calendar Hits (Festival) mono only R66-469.

Interest: Film star of the forties.
Performance: Pleasing style.
Quality: Not good.

Deanna Durbin had a relatively brief career as a film star, but during the period she was top billing she must have made more than a dozen films and goodness knows how many recordings of the type of song presented here—mainly evergreens and classically orientated numbers. Her small, clear soprano won for her a wide audience, and I imagine it will be those of her past fans with nostalgic memories who will want this disc, despite its disadvantages of very outdated sound quality and residue of surface noise from the 78rpm masters used. It is easily discernible from this release that she possesses a very sound musical training, and no doubt had visions of being an opera star at one time. Unfortunately, her voice did not have the necessary power for the arduous career of an opera diva. I do not know if anybody has previously invented the word "sopranette," but if not I claim the honour in applying it to Miss Durbin.

Tune titles are: Spring Will Be A Little Late This Year — Musetta's Waltz Song — Amopola — When April Sings — La Estrellita — The Turn Table — Always — Les Filles de Cadiz — Because — Blue Danube Dream — Poor Butterfly — Kiss Me Again. If you were one of Deanna's fans 20 years ago you will certainly recognise all these. (H.A.T.)

★ ★ ★

LAURIS ELMS. Recital of songs by Schubert, Liszt and Duparc. Piano accompaniment by Geoffrey Parsons. E.M.I. Stereo OASD7357.

Interest: Australian contralto.
Performance: Very satisfying.
Quality: Good standard.
Stereo: Well spread.

With this disc, another outstanding Australian singer makes her recording debut. Miss Elms has a wonderfully dark and warm voice and I feel sure she will be making many more discs in the future. In this recital she presents a group of five songs by Schubert: Aufenthalt—Gretchen am Spinrad—Standchen—Die Junge Nonne—Fruhlingsglaube; two songs by Liszt: O, Quand Je Dors—Die Loreley; and two songs by the Frenchman Duparc: La Vague et la Cloche—L'Invitation au Voyage.

Although this is Miss Elms' first recording, she is by no means inexperienced, as she has performed in opera at Covent Garden and in Australia for the Elizabethan Opera company. Her interpretation of the Schubert songs shows an understanding for the special requirements of lieder singing which cannot fail to please those who appreciate such works. My own reaction to the other songs was not so favourable but, in all fairness, I must say that this is probably due to a lack of sympathy with Liszt and unfamiliarity with the style of Duparc.

Geoffrey Parsons (another Australian artist, now normally resident in London) contributes a satisfactory piano accompaniment. The recorded sound is of good standard. (H.A.T.)

★ ★ ★

THE INCOMPARABLE VOICE OF PAUL ROBESON. World Record Club, two 10in discs, mono only, 4375-6.

Interest: Unique bass voice.
Performance: Superb.
Quality: Good remasters.

Paul Robeson is one of a select band whose voices can be styled unique—in my lifetime, anyway. In the same category I place very few others, among whom are Caruso and Kathleen Ferrier. Trained in law, it was almost by accident that he became first an actor, and then a singer. He is 70 years old this year, so was well past his best when the L.P. disc appeared on the recording scene. For this reason, he has made very few modern recordings—moreover, he has lived in Russia for many years. The tracks on this two-disc set are all remastered from his early 78rpm discs, when he was at the height of his career, so their represent Robeson at his best—and what a wonderful best that is.

Included in this selection are just about every track a Robeson fan would wish to find: Old Man River—Trees—Songs My Mother Taught Me—Night—The Rosary—Solitude—St. Louis Blues—Mighty Lak a Rose—Mood Indigo—Deep River—Ma Curly Headed Baby—Carry Me Back to Green Pastures—I Still Suits Me—Just A Wearyin' For You—Swing Low, Sweet Chariot—My Old Kentucky Home—Fat Li'l Feller Wid His Mammy's Eyes—Short'nin' Bread — Song of the Volga Boatmen — Wagon Wheels—My Way. While in no sense high fidelity material, these tracks have been very well remastered, and background noise is very low indeed. I have no hesitation in recommending these absorbing discs to Robeson fans. (H.A.T.)

Very Briefly . . .

ROMANCE. The Vienna State Opera Orchestra conducted by Hans Hagen. Universal Record Club. Stereo U896 (or mono).

Light classics, of course, and a good selection, too, but the orchestra is mediocre and the technical side below standard. The 12 tracks include Minute Waltz (Chopin)—Liebestraum (Liszt)—G. minor and C sharp minor Preludes

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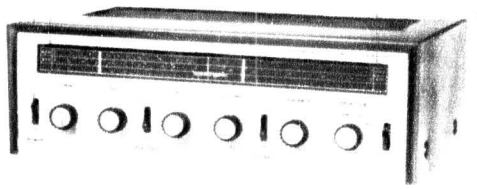

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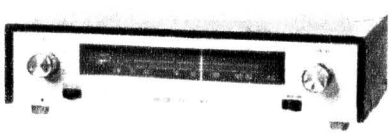

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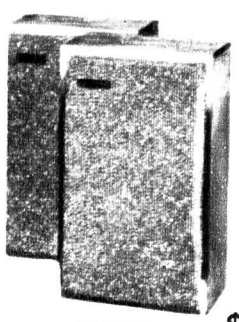

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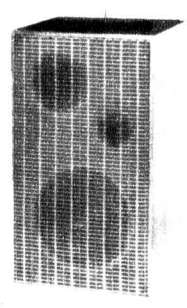

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CLASSIC RADIO

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(Rachmaninoff)—Intermezzo to "Cavalleria Rusticana" (Mascagni). U.R.C. members with a taste for light classics would probably find the enjoyable "Serenade" disc (UP761) a better choice. (H.A.T.)

ECHOES OF HOLLYWOOD, VOL. 2, Wilbur Kentwell. Mono, E.M.I. Encore Series OEX9405.

Re-released on the economy Encore label, this album which Australian organist Wilbur Kentwell made some years ago, is still good buying for those who are partial to the Hammond organ. Teamed up with the well-known string bass player, Reg ("Swivel Head") Robinson, he presents a medley of 26 tunes from M-G-M pictures, tunes like Alone—San Francisco—Donkey Serenade—Over The Rainbow—Temptation —You Are My Luck Star—and so on. It's best played at low volume, where the heavy bass beat is less apparent. (W.N.W.)

JANE MORGAN. A Jane Morgan Happening. Universal Record Club Stereo U897.

Top rating Jane Morgan demonstrates once again what a talented performer she is in a collection of established favourites and some of her own novelty numbers, including Night Life, Cincinnati, Ohio—The Marvellous Toy —North—My Funny Valentine—Smile —A Child (11 tracks in all). Excellent sound and stereo, originally recorded by A.B.C. Records. (H.A.T.)

LIZA MINELLI. A. and M. (Festival). Stereo SAML932828 (and mono).

Liza Minelli's first record for Herb Alpert's company. It should please her fans as it contains her current hits and is recorded in the high quality sound for which A. and M. discs are noted. The 10 tracks include The Debutante's Ball—Happyland—The Look of Love—Married—So Long Dad—My Mammy. (H.A.T.)

A TOUCH OF SADNESS. Jim Reeves. RCA Stereo, LSP3987.

One Jim Reeves disc is very much like another and from its large stockpile of tracks made by this singer before his death, RCA has released a further 11 tracks, including I'm Crying Again—Lonesome Waltz—Your Wedding—Missing You—I'm Glad Your Better. As the title implies, the songs are all of the sentimental, tearjerker variety. Sound quality and stereo are quite up to standard. (H.A.T.)

Popular Jazz

JACKPOT — Dave Brubeck Quartet. CBS Stereo SBP 233508.

Interest: Probably the Quartet's last recording.
Performance: Relaxed and lighthearted.
Quality: Reasonable for location recording.
Stereo: Poorly balanced.

For more than a decade, a favourite pastime of jazz critics the world over has been to malign the Brubeck Quartet. I must confess that, with the exception of Paul Desmond's graceful alto playing, the Quartet has held little more than a passing attraction for me.

However, I rather enjoyed this L.P. —presumably the last we will get from them as a working group, now that they have gone their separate ways. It was, incidentally, recorded in 1967, in the Tropicana Hotel, Las Vegas, before an enthusiastic audience.

At this stage in Brubeck's career, it is hard to find anything fresh to say about his heavy-handed and unswinging playing. On this set, he is somewhat over-featured, considering his limited talents as a jazz pianist. (In addition, the piano is out of tune.)

Paul Desmond, as usual provides the moments of real interest on the album with his gentle, flowing lines and his sophisticated melodic qualities. He contributes particularly warm and elegant solos on the two best tracks, "You Go To My Head" and "Out of Nowhere."

Gene Wright and Joe Morello have their own features ("Rude Old Man" and "Jackpot" respectively), but both are much too long to sustain interest.

Nostalgic Brubeck collectors will probably want to buy this for its historical value. But it cannot really be recommended as anything more than a pleasant, light-hearted and thankfully gimmick-free Brubeck session. The playing time, however, is exceptionally good at 51 minutes. (T.F.C.)

★ ★ ★

THE GERSHWIN PROGRAM (1941-45)—Eddie Condon and Co. Volume 1. Festival Jazz Heritage Series. Mono DL32866 (also available in "stereo").

Interest: Typical Condon of mid-1940s.
Performance: Thoroughly enjoyable.
Quality: Well re-mastered.
Stereo: "Electronically re-channelled."

The tracks on this new release in Festival's generally excellent Jazz Heritage Series are not quite up to the standard of Condon's slightly earlier Commodore sessions, but it is still a very worthwhile reissue.

The album is built around eight typical Condon tracks—four from December, 1944 and two each from May and June, 1945. Two of these, "Someone To Watch Over Me" and "The Man I Love," have superb vocals by Lee Wiley. Her husky, warm voice and superb feeling for a lyric were particularly suited to these beautiful Gershwin ballads.

The other Condon tracks, which include "Somebody Loves Me" (vocal and solo by Jack Teagarden) "Lady Be Good" (excellent Max Kaminsky), " 'S Wonderful" and "Swanee" retain much of the spirit and spontaneity of Condon's famous Town Hall Concerts and his definitive Commodores.

Condon usually managed to surround himself with first-rate musicians and people like Max Kaminsky, Pee Wee Russell, Gene Schroeder, Billy Butterfield and Bobby Hackett contribute some excellent solos on these tracks.

The playing time of 35 minutes (much too short for a $5.75 reissue) is made up with two rather commercial but pleasant tracks by Bobby Hackett's 1943 band; "Summertime," a rather disappointing 1941 Joe Sullivan piano solo; and "Fascinating Rhythm," a delightful 1951 Jess Stacy Quartet track, which spotlights the leader's crisp, bouncy piano.

All in all, this is not an essential record by any means but one which all nostalgic Chicagoans like myself will thoroughly enjoy. (T.F.C) ■

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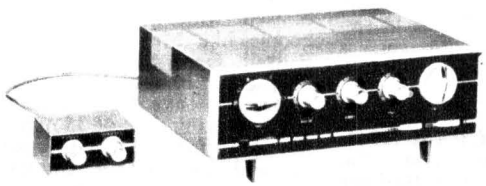

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MAIL ORDER SPECIALISTS

TRADE REVIEWS AND RELEASES

AUDIO-TECHNICA ARMS, CARTRIDGES

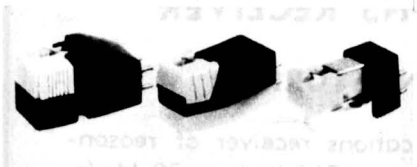
Pictured are a range of tone arms and magnetic cartridges which were recently submitted for review by Jacoby, Mitchell & Co., Pty., Ltd. They are made by Audio-Technica of Japan, a new manufacturer in the audio field.

The range of cartridges includes one which will retail for the very low price of $7.50. This is the A.T.6, and despite the low price, the claimed performance is impressive. Frequency response is quoted as 20-20,000Hz ± 2.5dB; compliance as 20ucM/dyne; tracking weight as 1.5 to 5 grams; output as 5mV (1000Hz, 50.8 mm/sec.).

The next up the price scale is the A.T. 3S, retailing at $13.95. Claimed performance for this is: Frequency response, 20-21,000 Hz ± 2dB, compliance; 22ucM/-dyne; tracking weight, 1 to 3 grams; output, 5mV (1000Hz, 50.8mm/sec.).

The top-of-the-line unit is the A.T.7S, retailing at $32.95. The specification sheet quotes: frequency response, 10-25,000Hz ± 2.5dB; compliance, 30ucM/dyne; tracking weight, 0.8 to 2.5 grams; output, 5mV (1000Hz, 50.8mm/sec.).

As we noted in the June issue, the cartridges have a neat appearance and appear to be well made. They are presented in a plastic case in which they are secured with the standard mounting screws. All cartridges have the standard ½-inch mounting centres and have removable stylus assemblies similar to those on some American cartridges.



The cartridges from left to right: A.T.6, A.T.3S and the A.T.7S.

Unfortunately, the manufacturer appears to be having quality control problems as the two dearer cartridges available to us performed poorly on actual test. This, in spite of favourable reviews in some overseas magazines. They would not track heavily recorded grooves at all well, and stereo separation was especially poor.

On the other hand the AT-6, cheapest of the cartridges, performed very well considering the price at which it is offered. Using a precision AC millivoltmeter, the CBS STR-100 test record, and with the cartridge terminated into a 47K load, the frequency response checked out at ±2dB from 50Hz to 16KHz apart from a well damped peak of +5dB at about 12KHz — apparently the system resonance. There was a gradual roll-off above 16KHz to —8dB at 20KHz.

Separation between channels ranged from a maximum of 20dB to a minimum of 13dB in the vicinity of the system resonance. Allowing for building and turntable rumble, which tend to diminish the difference between gross output readings, the separation between signal components would be quite adequate.

We used a tracking weight of 3 grams which was sufficient for all normal requirements. At this weight it handled the +12dB drum recording on the W and G 25/2434 test record quite comfortably. This cartridge would therefore seem to be a good choice for use in modern record changers. At its price it would be a better proposition than most of the ceramic cartridges currently on the market. However, it would have to be followed by a stereo preamplifier with full RIAA compensation.

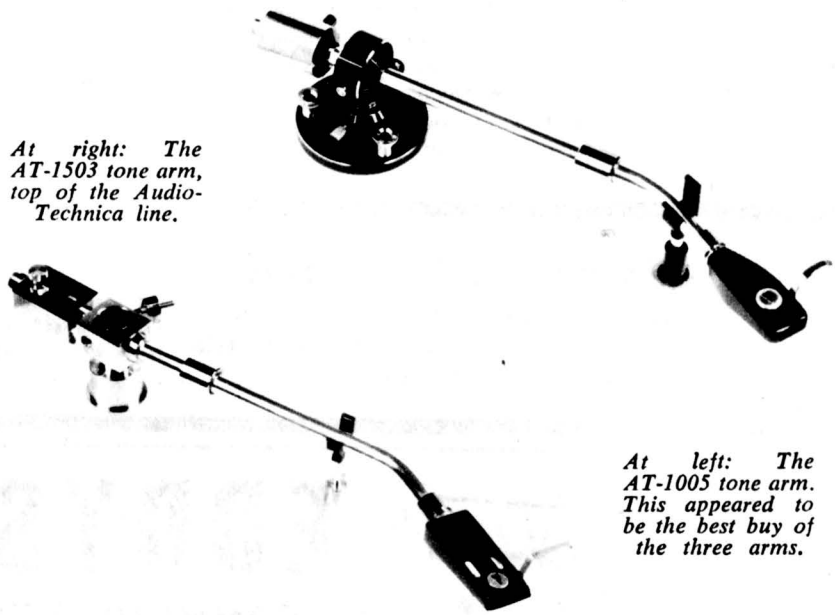
Three arms were submitted, namely the AT-1901, retail $18.75; AT-1005, $37.50; AT-1503, $46.75. The dearest of these, the AT-1503 is about 13 inches long and has an effective length of 10 inches from pivot to stylus. It has adjustments for height and longitudinal balance. Playing weight is adjustable from 0 to 3 grams by means of a weight which slides along the arm. The head shell has the standard E.I.A. type locking collar, as fitted to S.M.E. and Ortofon arms. There are three cartridge mounting positions in the head which gives a range of stylus overhang adjustment.

The height adjustment can be set firstly by means of the three screws in the mounting flange and secondly by the knurled screw on the base of the arm. We noted, however, that if the arm is used at its minimum height setting, as shown in the photograph, the arm may bind due to the excess lead length from pivot to the socket in the base assembly. The arm is supplied with a cable which is fitted with RCA phono plugs at one end and a 5-pin plug at the other end to match the socket in the base.

The second arm, the AT-1005 has an overall length of about 12¼ inches and has an effective length of 9¼ inches from pivot to stylus. It has adjustments for height, longitudinal and lateral balance. Playing weight is adjustable from 0 to 3 grams as on the above arm. In both cases we found the half gram calibrations quite accurate. Again, the arm is supplied with a connecting cable, as in the case of the arm above. This arm appeared to be the best value for money of the three. It had low bearing friction, tracked easily at stylus pressures below 1 gram and was generally a pleasure to use.

The cheapest of the arms does not come equipped with a connecting cable and has a rather unusual method for setting the tracking weight. The balance weight is split in two sections, one section sliding upon the other. Graduations are marked on the fixed section and these presumably are used to set the tracking weight. The graduations were not calibrated and no instructions or mounting template were supplied with the arm, as was the case with the two more expensive units.

Inquiries for Audio-Technica products should be directed to the importers, Jacoby, Mitchell and Company Pty. Ltd., 469-475 Kent Street, Sydney, or their interstate offices. (L.D.S.).



At right: The AT-1503 tone arm, top of the Audio-Technica line.

At left: The AT-1005 tone arm. This appeared to be the best buy of the three arms.

A.E.E. CAPACITORS NOW IN SYDNEY

Melbourne based A.E.E. Capacitors Pty. Ltd. has now established office and warehouse facilities in Sydney, at 134 Barcom Avenue, Rushcutters Bay, 2011 (phone 31-0941). The initial staff are Mr Bob Ison, Mr Barry Hancock and Mr Harry Harman. The Sydney branch will stock a comprehensive range of A.E.E. capacitors, comprising foil and paper, foil and polyester, polycarbonate, polystyrene, polypropylene, metalised paper, metalised polyester and metalised polycarbonate types.

If you could custom-build your next turntable. . . and you were a perfectionist . . . you would possibly construct an

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This is the all-Australian turntable that stands the test of time. Each unit is individually hand-crafted with painstaking care — each turntable is micro-balanced for perfect performance. Compare the engineering — compare the features!

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INTERSTATE REPRESENTATIVES:

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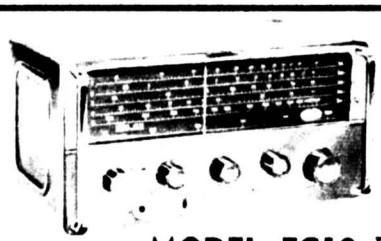
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1422
S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844
Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 2 5322
W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861



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MODEL EC10 550 kc/s to 30 Mc/s **TRANSISTORISED**

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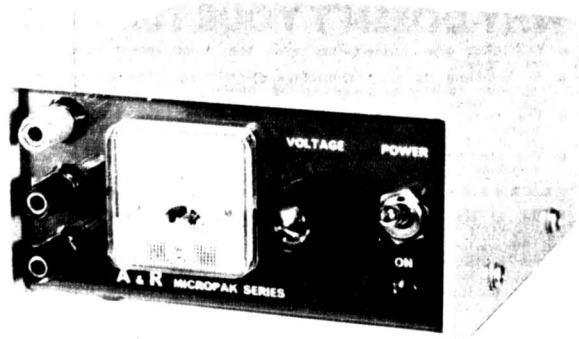
S.A.: K. Farmer Sales Pty. Ltd., 286 Gilles St., Adelaide—23-6131

PRECISION POWER SUPPLY FROM A & R

A compact DC power supply designed primarily for use with integrated circuits, and which has excellent stability and regulation, has been produced by A&R Electronics Pty. Ltd., 42-46 Lexton Road, Box Hill, 3128.



The unit will deliver from 2V to 6V DC at 1A maximum. While it may obviously be used in any situation where voltages and currents of this order are required, the unit is particularly suitable as a power source in developmental work where a high order of stability and regulation is essential.

A sample unit, illustrated alongside, was submitted for review by the manufacturer.

Before testing, we examined the interior of the unit and could find nothing to criticise in either the engineering or construction. It seems obvious that particular pains have been taken to produce a rugged unit which will stand up to hard use. Silicon transistors have been used throughout and the printed wiring board carrying the small components is of fibreglass. The case is of heavy gauge aluminium, finished in two shades of grey. Overall dimensions are 5¼ x 7 x 2 7/8in and weight is 4lb 6oz.

On the front panel are an ON/OFF switch, a voltage output regulator, a small voltmeter graduated from 2V to 6V to monitor output voltage, and three input terminals for positive, negative and earth. The third terminal allows either positive or negative output terminals to be grounded, or the supply may be operated floating.

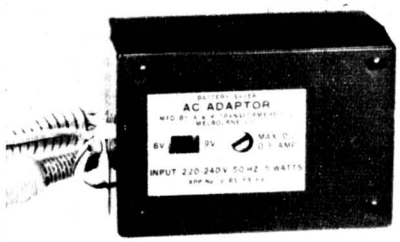
On test, the unit performed extremely well, and easily met the manufacturer's claimed performance of 0.05 per cent load regulation and 250uV P/P ripple and noise. Departure from the selected output voltage, tested at full load and no load was virtually unmeasurable, at 6V and 3V, while ripple and noise was measured at somewhat below 120uV at full load.

This excellent regulation is achieved by the use of an integrated circuit operational amplifier operating as a high-gain differential comparator in conjunction with a zener diode. Any departure from output voltage is fed back to the integrated circuit amplifier and delivered to the output in opposite phase, to retain the output within close limits This circuitry also protects the transistors against shorted output load.

Price of the unit is $85 (plus tax, if applicable) and it may be obtained through normal trade channels.

Also pictured is a small "battery saver" type power supply type PS64 which has been marketed very successfully by A&R for the past 12 months or so. Designed to provide either 6V or 9V at up to 300mA, it was originally reviewed in these columns in October, 1967.

Recently, we had the opportunity of conducting tests with the PS64 supply in conjunction with a Philips EL3302 portable tape recorder With the supply set for a nominal 6V output, the meter reading on the recorder was about the same as for internal batteries that are somewhat less than new but the recorder worked quite normally in this condition, with no sign of wow or flutter, no significant hum and with normal power output. Philips advise, however, that the circuitry of the recorder will tolerate the higher voltage without distress and use can be made of this fact in situations where the maximum possible power output is required.



Type PS 64 Battery Saver

Price of the PS64 supply is now slightly cheaper than when first announced, the figure being $13.88 retail including Normal trade discounts apply.

A & R also have available the type PS82 battery saver supply, providing either a nominal 6V or 9V output, but at a maximum load of 100mA, and suitable for transistor radios, as distinct from portable tape recorders. The PS82 has the same overall dimensions as the PS65—3½ x 2½ x 2 inches—but is distinguishable by its ivory case. Employing rather simpler circuitry than the higher rated unit, the PS82 sells for $8.75 including tax, less trade discounts where appropriate. (H.A.T.).

"LOCKFIT" TRANSISTORS

The Miniwatt Division of Philips Electrical Pty. Ltd., and Mullard Australia Pty. Ltd., have simultaneously announced the availability of a new range of "Lockfit" transistors.

The Lockfit range has been designed to simplify some aspects of automatic assembly of consumer type goods, and are all silicon planar epitaxial types contained in an epoxy resin body. The shape of this body is assymetrical but regular, and is designed to be self-orienting in automatic assembly machines (figure 1). The pins are self-locking in printed wiring boards, and are shaped so as to be compatible with either of the two most commonly used board thicknesses in use (figure 2).

The spring set of the pins in conjuction with the special shape provides a push to fit insertion into printed boards.

The pins are gold plated and the special shape and spring set provides an intimate contact with the copper track of the printed wiring. Each pin has four principal shoulders. For printed boards of 1mm thickness, shoulders C and D act as buffer and lock respectively (figure 3); for printed boards of 1/16in thick, shoulders A and B act as buffer and lock (figure 4).

The first release from Mullard comprises the BC147 driver; BC148 amplifier; BC149 low-noise pre-amplifier; BF194 IF amplifier; BF195 RF and IF amplifier. These are NPN types.

In addition to the above, the first release from Philips includes the following PNP types: BC157 general purpose; BC158 audio; BC159 low-noise audio.

Further information, technical specifications, dimensions and a description of a method for inserting the Lockfit transistors by hand are contained in "Mullard Outlook," Vol. 11, No. 2; and in "Miniwatt Digest," Vol. 7, No. 2. Additional information can also be obtained from the Miniwatt Division of Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064; and from Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, N.S.W. 2000; or from interstate offices of both companies.

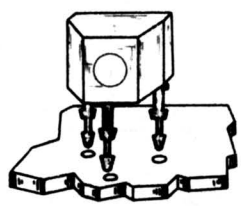


Figure 1

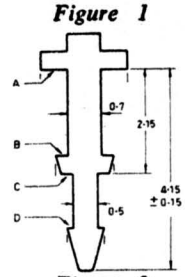


Figure 2

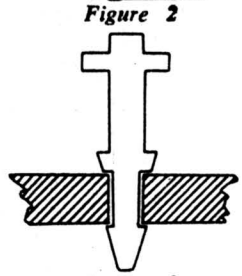


Figure 3

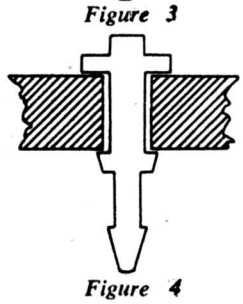
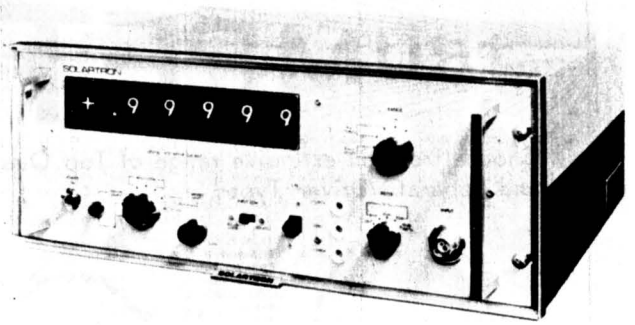


Figure 4

THREE NEW INSTRUMENTS

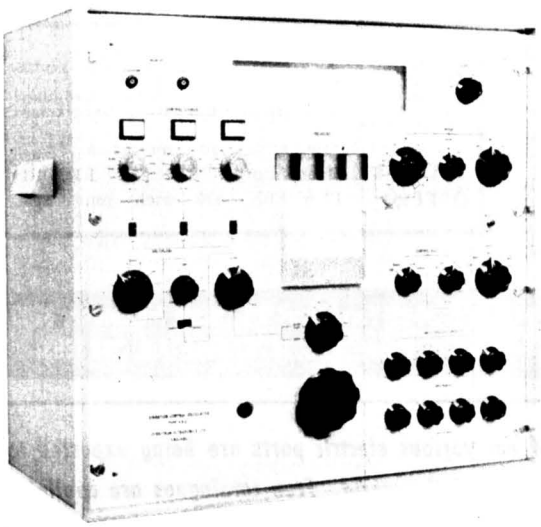
Information on three new instruments from overseas has reached us from the importers.



Solartron LM.1867 Precision Digital Voltmeter.

SOLARTRON LM.1867 PRECISION DIGITAL VOLTMETER. This is a six-digit instrument, and is the most accurate Solartron have yet produced. It uses the successive approximation technique, employing precision resistors. The working voltage reference is a multi - junction zener diode maintained at 115 degrees C in a proportionally controlled oven. Over-ranging provides six figures at decade voltage levels, thus giving 0.0001 per cent resolution when calibrated against the built-in Weston Standard cell. The long full-scale allows high accuracy to be maintained down to the normal range change point (1/10th of full scale). The voltmeter reads from 10uV to 22KV at rates up to 50 conversions per second. BCD printout signals are available from an optional fan-out unit.

For further information, contact Solartron Australia, 112 High Street, Kew, Victoria 3101.



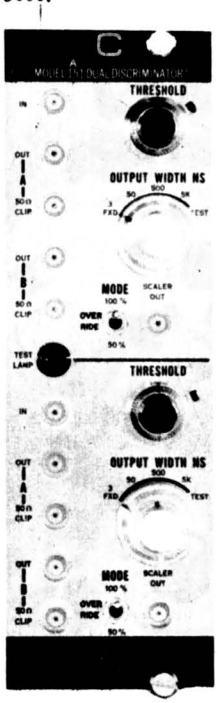
DERRITRON VIBRATION GENERATOR. The vibration generator is intended primarily for use as a sine wave source for environmental vibration testing of equipment and materials. It comprises a motor driven sine wave oscillator and incorporates a control system which accepts an input from an accelerometer and maintains the sine wave output within certain limits as required. Features of the instrument are the built-in frequency counter; automatic operation for displacement, velocity and acceleration signals; operation of the compressor time constant circuits from a photodiode arrangement; very versatile and accurate frequency, sweep limit controls; and a built-in accelerometer pre-amplifier.

LEFT: Derritron Vibration Generator, Model VCO.1.

BOTTOM LEFT: Chronetics Model 151A Voltage Sensitive Discriminator.

The equipment is fully transistorised and operation is from mains supply. A totally free-standing case is supplied as standard measuring 18¼ x 19¾ x 11in. A version suitable for rack mounting is also available.

Further information concerning price and availability can be obtained from British Merchandising Pty. Ltd., 49-51 York Street, Sydney, N.S.W. 2000.



MODEL 151A 200MHz VOLTAGE SENSITIVE DISCRIMINATOR. This instrument, made in the U.S.A. by Chronetics, Inc., is a module of that company's Nanologic 150 system, a counting and logic system for high energy physics, fast memory testing, transient analysis and semiconductor voltage tolerance and switching measurements.

Model 151A consists of two identical, isolated voltage-sensitive discriminators in a single RF-shielded case. The discriminator will fire at, and only at, a pre-set level and will not misfire or refire in the presence of long-duration inputs. Duty cycle is 100 per cent, deadtimeless. Switch selection of updating mode is provided. In the updating mode the unit may still be triggered even if the output is already in its "on" condition. A DC override is provided to eliminate dead time and duty cycle limitations. In this mode, output width equals present value or input width at the threshold level, whichever is the greater.

Full technical specifications and information on price and delivery can be obtained from Racal Electronics Pty. Ltd., 75-77 Chandos Street, Crow's Nest, N.S.W. 2065.

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Choose from an extensive range of Top Quality Unipex Speakers — including Combination and separate Driver Types.

H.25. Horn Speaker. Trade Price $22.70 plus Sales Tax.

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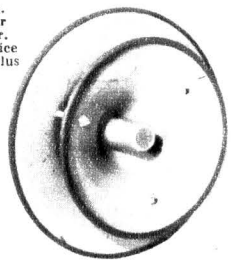
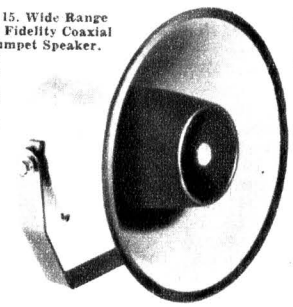
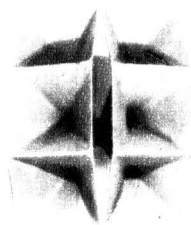
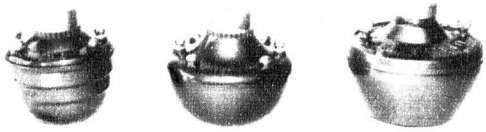


OB 15. Wide Range High Fidelity Coaxial Trumpet Speaker. 150 to 15,000 C.P.S. Trade Price $47.15 plus Sales Tax.



SH.C. 6 Throat Cast Aluminium Horn Speakers —One Driver Unit Entry. Trade Price $49 plus Sales Tax.





Driver Units. Matching Driver Motors and Transformers available from 15 to 35 watts. All wattage R.M.S. Selective range of Sato, Bezels, Knobs, Fuse Holders, Key Switches, Terminals, etc.

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SPECIAL OFFER! Heavy duty "PRINCESS" RECORD PLAYERS, $10 each plus Tax.

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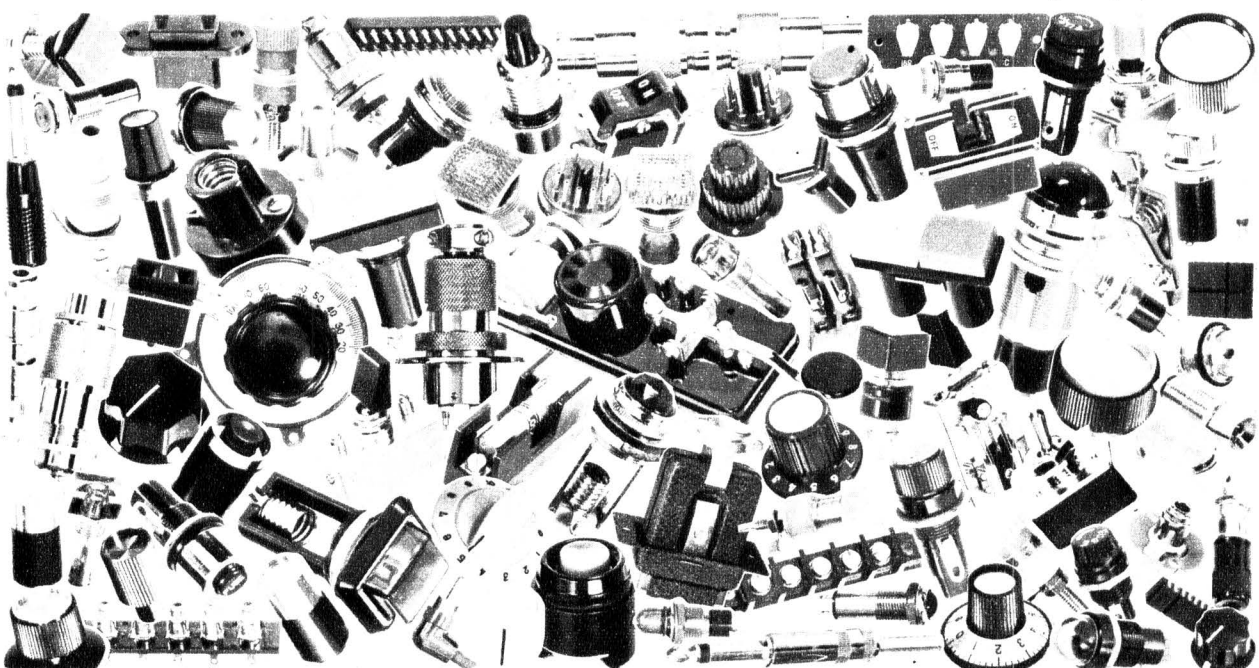

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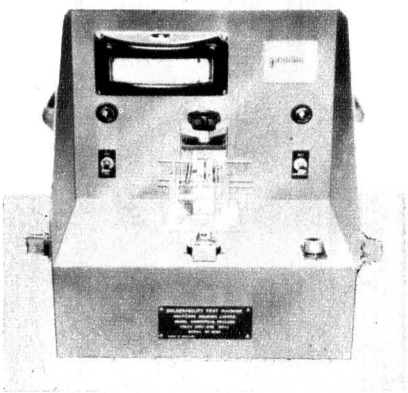
SOLDERABILITY TESTER

An instrument for assessing the solderability of component termination wires has been developed in U.K. by the parent company of Multicore Solders (Aust.) Pty. Ltd.

The Multicore Solderability Test Machine is available through the Appliance and Equipment Division of Greendale Engineering and Cables Pty. Ltd., who are the sole selling agents in Australia.



The machine is designed to assess solderability simply and accurately and thereby ascertain that the termination wires of components will not give rise to manufacturing difficulties.

The method consists of lowering a specimen of the wire, previously fluxed, horizontally on to a molten globule of solder, dividing the solder into two parts. The time in seconds taken for the solder to flow around the wire and unite above it is an inverse measure of the solderability of the wire. A fresh pellet of solder is used for each test, the size of the pellet being determined by the diameter of the specimen wire. Either complete components or separate specimens of wire can be accommodated.

The manufacturers say that although this is a simple test, to be acceptable its operating functions must be exactly repeatable for every test and between different models of the same instrument. The design of the tester has been based on achieving this requirement to the highest possible degree of accuracy.

The machine is built to British Standard Specification BS2011, which covers the basic method of testing electronic components. For further information on the machine, contact the Appliance and Equipment Division of Greendale Engineering and Cables Pty. Ltd., 43-53 Nelson Street, Annandale, N.S.W. 2038.

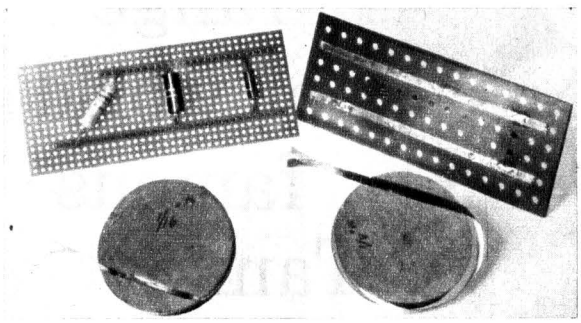
INSTANT PRINTED WIRING

Self-adhesive copper laminate in strip form for the construction of circuit boards is now available in Australia from Jacoby, Mitchell and Co. Pty. Ltd.

The material, called Cir-Kit, provides a relatively simple alternative to making wiring patterns by the etching process. The material consists of thin copper foil with an adhesive backing covered with protective paper. The strips can be cut to length with a pair of scissors, a sharp knife or a razor blade. These can then be stuck down on a base, which can be laminated plastic, wood, or even stiff cardboard.

Advantages claimed for the system are that the layout can be constructed to match closely with the circuit diagram, by laying the strips in the same way as the lines are drawn, thus making checking, circuit reading and fault location easier; it is possible to lap strips at crossover points (often seen in circuit diagrams) without short circuiting, since the adhesive materials is a good insulator; errors can be easily corrected by lifting and adjusting the strips.

From our observations, we feel that the material would be useful for experimental circuits of a relatively simple nature, but that there may be limitations to the complexity of circuits which could be built up. Although the makers claim that the adhesive is sufficient insulation for lapped strips, it would appear to be safer to leave a short piece of the backing material in position at actual crossover points.



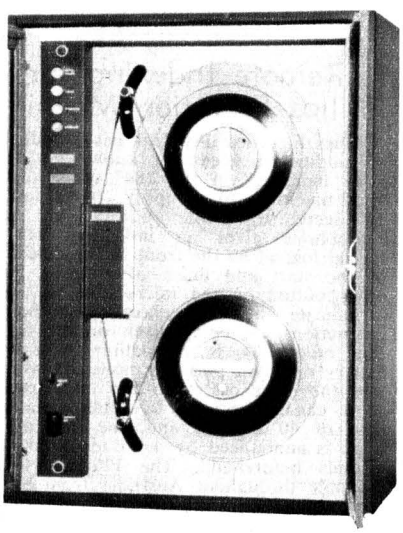
Cir-Kit is available in two widths, 1/16in wide and 1/8in wide, and is supplied in 100ft coils. The price is the same for both sizes, at $5.44 per 100ft. Inquiries should be addressed to Jacoby, Mitchell and Company Pty. Ltd., 469-475 Kent Street, Sydney, 2000.

Incremental Digital Tape Recorder

A range of digital incremental tape recorders made in the U.K. by Thermionic Products (Electronics) Ltd. is available in Australia through Tape Recorders Pty. 49-51 York Street, Sydney, 2000.

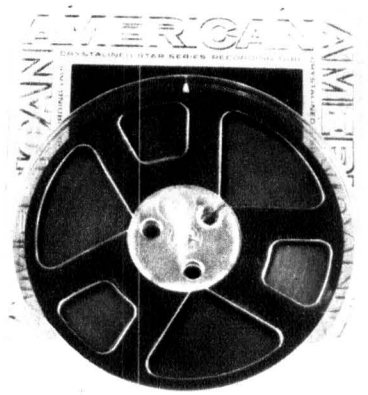
Illustrated below is the T.5050 incremental recording system which takes 10½in spools of ½in wide tape (2,400ft) on which can be recorded over 120 million bits of information in IBM computer compatibile format. This transportable equipment is of solid-state modular construction, and uses brushless motors.

Additional facilities which can be provided include echo check, parity generation, inter-block gap end of file generation, and special interface for different logic levels.



"AMERICAN" TAPE

H. Levinson Pty. Ltd. announce that they have available stocks of AMERICAN "Star Series" recording tape. This is on a Mylar base, with a coating specially formulated with a view to good performance at slow recording speeds.



The distributors claim that the specially formulated coating ensures very low noise and a virtual absence of dropouts at any speed.

However, parameters of the coating have been manipulated so that it will give optimum performance at the slower speeds (e.g., 1-7/8ips) at the bias level which is commonly available in domestic recorders. According to the manufacturers, recorders are conventionally preset to produce the bias level required by normal tapes at the higher speeds, notably 7½ips. When these same tapes are used at slow speeds, without an upward adjustment of the bias level, performance suffers.

Aim of the Star Series tape is to counter this loss, making it more practical to use a slower speed, thereby gaining extra playing time without the disadvantages associated with very thin tapes—mechanical frailty and a tendency to print-through.

Prices are as follows:

ST6M	600ft	1½mil/5in reel $3.85,
STL9M	900ft	1mil/5in reel $5.35,
ST12M	1200ft	1½mil/7in reel $6.65,
STL18M	1800ft	1mil/7in reel $9.25.

Further information regarding specifications and availability can be obtained from the distributors, H. Levinson Pty. Ltd., 368 Post Office Place, Melbourne, Victoria, or their interstate offices.

Remote Indexing for Philips Dictation Machine

Philips Electrical Pty. Ltd. has introduced an additional accessory known as "remote indexing" in the "84" office dictation machine to simplify transcription by secretaries. One button on the microphone gives an indication on a special logpad on the front of the machine of the start and finish of a letter. Another button on the microphone is used to indicate where corrections or additional instructions are being given on the tape. The model 84 is compatible with the battery operated portable model 83 which uses the same cassettes. The twin tracks of a cassette provide a total dictation time of 40 minutes and, the end of a track is announced by a buzzer about 20 seconds beforehand. The Philips 84 is available throughout Australia from Stott and Underwood Ltd., from whom further details may be obtained.

TRADE RELEASES—IN BRIEF

AMALGAMATED WIRELESS VALVE CO. PTY. LTD., has supplied data on the following RCA semi-conductors:

CA3028A and CA3028B monolithic silicon IC differential/cascode amplifiers for use in communications and industrial equipment from DC to 120MHz;

CA3043 monolithic silicon IC special function sub-system containing a multi-stage IF amplifier/limiter section, an FM detector section, a zener diode regulated power supply section, and an AF amplifier section;

CD2300, CD2300D, and CD2300E series consisting of 15 basic medium-power diode transistor logic (MPDTL) monolithic ICs in three package styles;

1N5411 bidirectional diode (diac) for triggering bidirectional triode thyristors (triacs);

40561-40574 axial-lead germanium tunnel diodes for high-speed switching and high-frequency signal processing applications;

40598 gallium arsenide infrared emitting diode;

2N5320-2N5323 silicon power transistors, complementary types for small-signal medium-power applications;

3N159 N-channel silicon depletion type dual insulated-gate field-effect transistor for RF amplifier application up to 300MHz.

Trade inquiries should be addressed to A.W.V. at 348 Victoria Road, Rydalmere, N.S.W. 2116.

TEKTRONIX AUSTRALIA PTY. LTD. advises that as from August 12, 1968, its Sydney office has moved to 80 Waterloo Road, North Ryde, N.S.W. 2113 (telephone 88-7066.) The company has also advised that a number of used instruments are available at a discount as they are no longer required for demonstration purposes. Inquiries to the company at any of its State offices.

GILMORE INDUSTRIES INC., Cleveland, Ohio, U.S.A., has introduced the 470 series of Digital Indicators suitable for the direct indication of voltage, temperature, speed, etc., when used with appropriate transducers. The indicators are true integrating digital instruments using the dual slope integration technique which compares each measurement with an internal reference to assure stability. This technique also eliminates the usual systematic error sources found in DVMs using the single ramp or voltage-frequency converter/counter circuits. Details are available from The Australian agents, Technical and Scientific Equipment Co., G.P.O. Box 1726P, Melbourne, Vic. 3001.

ELECTRONICS INDUSTRIES LTD., has introduced a 12in, square look, fully transistorised, portable TV set under its Astor brand name. This set, weighing only 23 pounds, has 40 solid state devices, including microcircuits. It has telescopic aerials with provision for attachment to an outside aerial in a weak-signal area. Inquiries to the company at 161 Sturt Street, South Melbourne, Vic. 3205.

INFORMATION ELECTRONICS LTD., a public company which plans to become the first locally owned manufacturer of computers in Australia, was registered in Canberra recently. The new organisation will begin production early next year of the IE 10000 computer, based on the design of the Intergraphic Computer which is being completed by a research team at the University of New South Wales. The company has negotiated an exclusive licence for the world rights to manufacture the machine. The company also will later manufacture other computers of its own design.

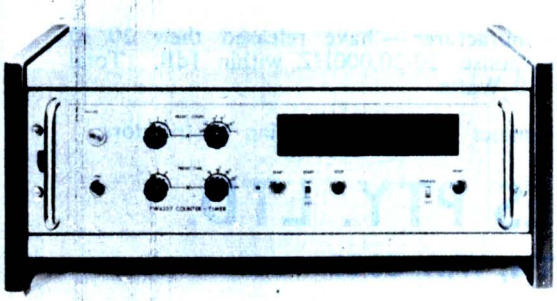
SINGER PRODUCTS CO. INC., has available a new Sonotone high-quality, omnidirectional, dynamic ball microphone. Designed for all types of on-stage performances, the head of the new microphone features an acoustical lined ball which permits the user to work in close proximity without causing popping and wind noises. The entire microphone element is floated in rubber, protecting against damage due to physical shock and minimising handling and clothing noise. For further information, write to the company at 95 Broad Street, New York, N.Y. 10004, U.S.A.

ROLA DIVISION of Plessey Components Group has introduced two new professional tape recorders. Designed as a general purpose model, the Rola model 66 MkII is suitable for studio or outside broadcasting with wide frequency range, low distortion, accurate timing, durability and freedom from noise. The Rola model 77 MkIII professional tape recorder is basically a portable unit yet provides all the facilities and flexibility of operation normally only found in studio console recorders. Details of these recorders may be obtained from the Rola Division, Plessey Components Group, The Boulevard, Richmond E1, Victoria.

STANDARD COMPONENTS PTY. LTD., 10 Hill Street, Leichhardt, N.S.W. 2040, announces a change of phone numbers. The new numbers are 660-6066 (eight lines) direct to sales department; 660-6389 and 660-6445 for all other inquiries.

Philips Counter-Timer

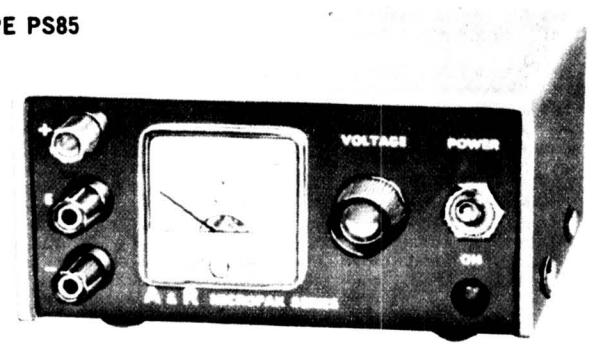
PHILIPS ELECTRICAL PTY. LTD. has announced a low-cost high-performance universal combined counter-timer with switchable digital display. Known as PW4237, it incorporates a separate counter and timer circuit, each with its own pre-set facility. The display panel can be switched to show either the counter or timer reading. The unit includes a 6-decade 1MHz counter, and an 8-decade timer. Results are read on a six digit in-line display. There are facilities for manual and remote control of start, stop and reset. Connection to data conversion and read-out equipment is provided by four separate outputs. Inquires to the Scientific and Industrial Equipment Division, Philips Electrical Pty Ltd., 69-79 Clarence Street, Sydney, N.S.W. 2000.



PRECISION D. C. POWER SUPPLY

For use with DIGITAL INTEGRATED CIRCUITS, Etc.

TYPE PS85



- All Silicon Semiconductor Circuity.
- Short Circuit Proof.
- High Gain Operational Amplifier for Maximum Stability.
- Small Size.
- Parallel & Series Operation Possible
- Temperature Range 0-55°C
- Either the positive or negative output terminal may be grounded or the power supply can be operated floating.

The A & R Micropak type P.S. 85 is designed primarily for use with Digital Integrated Circuits which require a supply voltage between 2 and 6 volts, but may also be used as a high quality power supply for any other purpose within its ratings. The circuit follows standard practice, but improved performance has been obtained by the use of an Integrated Circuit Operational Amplifier as a high gain differential comparator, thus giving excellent stability and regulation.

Manufactured by:

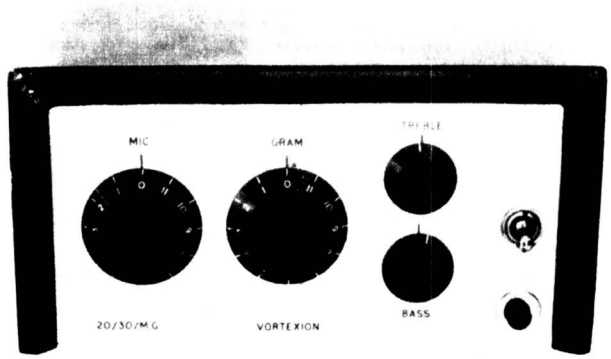
A & R ELECTRONIC EQUIPMENT PTY. LTD.
46 Lexton Rd., Box Hill, Vic., 3128
AGENTS IN ALL STATES

SPECIFICATIONS

A.C. Input: 105-130V or 210-260V 50-60Hz.
D.C. Output: 2-6V. 1A Maximum 1.2A Short Circuit.
Load Regulation: Less than .05% for full load current change.
Line Regulation: Less than .05% for ± 10% mains variation.
Ripple & Noise: Less than 250 uV Peak to Peak.
Temperature Co-Efficient: Less than .06% per degree Centigrade.
Output Impedance: Less than .05 ohms from D.C. to 1 MHz.
Size & Weight: 5½" Wide x 7" Deep x 2.7/8" High 4 lb. 6 oz.

S.A.	SCOTT THOMPSON P/L., 93 Gilles St., Adelaide	23 2261	N.S.W.	SOANAR ELECTRONICS P. L., 82 Carlton Cres., Summer Hill	798 6999
W.A.	EVERETT AGENCY P/L., 17 Northwood St., W. Leederville	8 4137	Q'LAND.	R. A. VENN P/L., 71-73 Doggett St., Valley, Brisbane	51 5421

FED UP WITH UNINTELLIGIBLE PUBLIC ADDRESS?



THEN MOVE UP TO

VORTEXION

the P.A. AMPLIFIER with the HI-FI SOUND:

In any Public Address System the Amplifier is the heart, and although microphones and loudspeakers play a big part in the final result, it is often possible to affect a tremendous improvement by replacing existing amplifiers with Vortexions.

Vortexion—Britain's most respected P.A. Amplifier manufacturer — have released their 20/30 Watt Mixer Amplifier, illustrated above. Frequency Response: 20-20,000HZ within 1dB. Total Harmonic Distortion. 0.1% at 20 Watts, 0.3% at 30 Watts.

For full details of this, or other Vortexion Amplifiers, contact the Sole Australian Distributors:

LEROYA INDUSTRIES PTY. LTD.

672 HAY STREET, PERTH, W.A. 6000

AIM ELECTRONICS LTD., of England, has developed a new lock-in amplifier which is claimed to be the first of its kind. It is a signal recovery amplifier which searches out and locks on to weak signals smothered by overwhelming noise without needing a reference signal of the same frequency as the lost signal. It may be used with electroencephalographs in diagnostic medicine to search for and amplify very-low-level brain waves.

The system incorporates a local phase-locked reference generator comprising a phase sensitive detector and a voltage programmed filter/oscillator. The frequency range is from 0.15Hz to 50KHz, and its maximum sensitivity is 100 nanovolts. The received signal may alter in frequency or amplitude and still be held locked. Price of the AIM System 5.2 is $2,075 and delivery is eight weeks. For further detail contact the Australian agents. Rutherford Electronics Pty. Ltd., P.O. Box 30, North Balwyn, Victoria 3104.

STANDARD COMPONENTS PTY. LTD., announces the Allied shorted turns tester. This fully transistorised instrument is suitable for all make of EHT transformers and yokes, and operates on a "Go" —"No-Go" system. It is claimed to be extremely sensitive, able to detect even one single shorted turn. Further information may be obtained from the company at 10 Hill Street, Leichhardt, N.S.W. 2040.

AUSTRALIAN RECORD CO. LTD., has established a new division known as C.B.S. Musical Instruments with exclusive rights in Australia of three lines of musical merchandise, including Fender guitars, amplifiers, etc. The products to be marketed are all owned and controlled in the U.S.A. by Columbia Broadcasting System Inc., of which Australian Record Co. Ltd. is a wholly owned subsidiary. Inquiries should be addressed to C.B.S. Musical Instruments. 11-19 Hargrave Street, East Sydney, N.S.W. 2010.

TELEPHONE AND ELECTRICAL INDUSTRIES PTY LTD., a Plessey Pacific subsidiary, has received orders worth over $60,000 for subscribers' meters and traffic meters for installation in Brazilian telephone exchanges. The units are to be delivered before the end of this year. The subscribers' meters ordered are similar to the call-registering devices supplied to the Australian Post Office.

AEGIS PTY. LTD., has designed and manufactured the coils required for the Playmaster 122 Program Source published in "Electronics Australia" August, 1968. These are the S201 oscillator coil, the S195/S196 band pass pair, and the ST545C IF transformer. Retailers may obtain stocks of these coils either from the factory at 347 Darebin Road, Thornbury, Vic. 3071, or from interstate representatives Watkin Wynne Pty. Ltd. (N.S.W.), P. H. Phillips Pty. Ltd. (Queensland), and Neil Muller Pty. Ltd. (South Aust.)

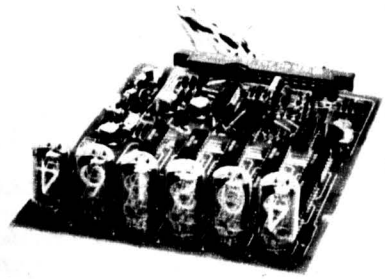
DELCO RADIO, Kokomo, Indiana, U.S.A., has introduced the JAN2N3902 NPN triple diffused silicon power transistor. This is designed for use in high-voltage applications requiring increased reliability over the 2N3902. High-voltage ratings make it practical to operate directly from a rectified 117V or 220V AC line. The maximum collector current is 3.5A while the maximum power dissipation is 100W. Inquiries to the Australian agents for Delco semiconductors, Industrial and Domestic Equipment Co., Box 163, P.O. Dandenong, Vic. 3175.

TEKTRONIX AUSTRALIA LTD., has announced the following items of test equiment. The solid-state type 528 Television Waveform Monitor provides bright, easy-to-read video waveform displays on a 5in CRT and is suited for monitoring signals from camera outputs, video system output lines, transmitter video input lines, closed circuit TV systems, and educational TV systems. The type 602 Display Unit is a compact, solid-state instrument with excellent resolution providing accurate displays of information from X, Y and Z signal inputs. The C-31 Trace-Recording Camera is a compact, high-performance camera designed for Tektronix portable oscilloscopes. Further details of these instruments may be obtained from the company at 80 Waterloo Road, North Ryde, N.S.W. 2113.

ASTRONIC IMPORTS, a division of Electronic Industries Ltd., held a private exhibition in July of equipment manufactured by Dawe Instruments Ltd. of England. Items exhibited included: Ultrasonic Cleaning devices; Sonoray Flaw Detector and Thickness Gauge; Leak Detector; Vibration Meters; AF Analysers; Sound Level Meters; Acoustic Calibrator; Audio and ULF Oscillators; Phase Meter; Strobotorch and Stroboscope. All inquiries should be addressed to the company at 121 Crown Street, East Sydney, N.S.W. 2010.

B.S.R. (A'SIA) PTY. LTD., has released a new series of mono cartridges on the Australian market. These are the X3M and the X3H, designed to play stereo records monophonically, important now that so many records are available only in stereo. B.S.R. says both cartridges have high compliance, good frequence response. They are a development of the B.S.R. X range and replace the X1M/H series. The X3M has a medium output and the X3H a high output. For further information contact the company at P.O. Box 61, St. Marys, N.S.W. 2760.

HEWLETT-PACKARD AUSTRALIA PTY. LTD. has introduced a Counter Board, model K01-5221A, which consists of a single 4-3/8in x 6½in circuit board with a low-cost electronic counter for use in equipment where ready-made counting



The Hewlett-Packard Counter Board model K01-5221A with 6-digit option.

ability or a digital readout is needed. It counts electrical events at rates up to 10MHz and displays the results on long-life Nixie tubes as a total or, when the count is gated for precise interval, as a frequency. It can also be used to measure time intervals. The board, which uses ICs extensively, includes all circuits but the power supply, input signal conditioner, and front-panel control functions. Inquiries to the company at 22-26 Weir Street, Glen Iris, Vic. 3146.

ALLIED CAPACITORS PTY. LTD. will market Centralab electronic components in Australia and New Zealand. This is an initial investigative step towards setting up a manufacturing facility in Australia for Centralab products. Centralab Electronics is a division of Globe-Union Inc., with offices in Milwaukee, Wisconsin, U.S.A., and produces a wide variety of components falling into six basic product groups: capacitors, integrated circuits, switches, technical ceramics, potentiometers, and semiconductors. Inquiries to the Australian company at 752 Pittwater Road, Brookvale, N.S.W. 2100. ■

SPECIAL PURCHASE–NEW B.S.R. TAPE DECKS
SUPPLIED WITH KIT OF PARTS FOR MONO PRE-AMP

These New B.S.R. single speed (3¾in) Tape Decks are fitted with Bradmatic two-track heads and will take spools to 5¾in. With each deck is supplied a mono transistor pre-amp kit as advertised separately on this page. Circuit of pre-amp is supplied.

$30.00

Post and Packing Extra—N.S.W. $1.25; Interstate $1.75.

NEW IMPORTED SLOT CAR KITS AT LESS THAN HALF PRICE

Complete kit of parts including 12V motor and full instructions.

$2.00 post 25c

NEW AMERICAN TWIN TELESCOPE TV AERIAL

Extends to 36in, each section can be used singly for car or portable . . . $1.50. Post 20c.

SINGLE TELESCOPIC

Aerial 12in extends to 33in. 60 cents. Post 10 cents.

NEW 4-SPEED STEREO PLAYER F.O.R. $23.50

NEW STEREO CHANGER, 4-SPEED F.O.R. $29.50

SLIDER-SWITCHES
10-pole 2-way silver-plated contacts 38c

POWER TRANSFORMER

Prim. 240V Sec. 350 volts a side. 60 M.A. One 6.3V, one 5V Fil.

$2.75 Post N.S.W. 60c. Interstate 80c.

72 ohm CO-AXIAL CABLE

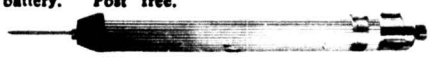
20c per yard. Minimum order 5 yards.

NEW SELENIUM RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt at 4 amp., $3.75. Post, N.S.W., 20c; Interstate, 20c. Transformer for above rectifier tapped for 6 to 12 volts, $4.75, Post, N.S.W., 75c; Interstate $1.00.
As above, 6 or 12 volt, at 2 amp., $2.75. Post, N.S.W., 35c; Interstate, 45c. Transformer for above, $3.75. Post, N.S.W., 35c; Interstate, 45c.

TRANSISTORISED SIGNAL INJECTOR $5.75

A MUST FOR QUICK TROUBLE SHOOTING Using TWO Transistors, complete with instruction sheet and battery. Post free.



NEW VALVES AT BARGAIN PRICES

7193	25c	1T4	45c	6H6G	35c	6SS7 equiv. 6SK7	85c
807	$1.75	3Q4	75c	6K7G	45c	6U7G	45c
1C7G	30c	3S4	$1.00	6K8G	68c	6X8GT	78c
1D8GT	95c	5V4G	$1.00	6S8	95c	7C7	38c
1K8G	40c	6B8	$1.00	6SA7GT	95c	12AT7	$1.00
1K7G	40c	6C8G	80c	6SJ7	98c		
1M8G	40c						
1P8G	28c						
1Q8G	28c						

1A7GT	75c
1L8G	95c
12SK7	80c
12A6	80c
12SK8	80c
12SH7	80c
866	1.80
954	25c
958	28c
EK32	68c

Please add postage on all valves.

NEW "TECH" V.T.V.M. MODEL TE65

23 RANGES. 240V. A.C. powered.

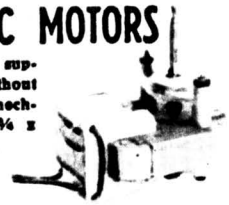
D.C.V. 1.5, 15, 50, 150, 500, 1,500
A.C.V. 1.5, 15, 50, 150, 500, 1,500.
D.B. —10db to +60db.
Resistance. 1 ohm to 1,000 megohm.

$42.50 **POST $1.00**

NEW 240V ELECTRIC MOTORS

3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

$2.75



New Electrolytic Condensers

These condensers are miniature pigtail type insulated new stock in packets of 12, each packet containing; 3 16mfd 300 V.W., 2 32 mfd. 300 V.W., 1 25 mfd. 450 V.W. and 6 low voltage electrolytics. **$2.50.**

Post and packing 20c extra.

NEW IMPORTED 4" P.M. SPEAKERS

Available with a 4 or 16 ohm voice coil. **$2.00.**
Post and packing 30c extra.

NEW MINIATURE MOTORS

Ideal for models, toys, etc. 1½ to 3 volts. 6,000 r.p.m. 39c each or $3.50 per doz. Post 10c.

NEW MIDGET POWER TRANS. $3.25

40mA prim., 240v. Sec 225 x 225 with 6.3v Fil. Winding. Postage: N.S.W., 25c; Interstate 45c.

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil. Winding.

$3.25 Postage: N.S.W., 25c. Interstate 35c.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding. 60mA, $5.50. Plus postage: N.S.W., 35c; Interstate, 52c.
Prim.: 240v, Sec. 385 x 385 at 80mA, fil. 6.3 and 5v, $4.50. Post.: N.S.W., 40c; Interstate, 75c.
60mA H.T. Chokes, 75c. Post.: 20c.

TYGAN AND SARLON SPEAKER GRILLE FABRIC

List price **$8.00** per yard.
To clear at **$5.50** per yard.

Postage and packing N.S.W., 35c. Interstate, 45c.

NEW B.S.R. TAPE DECKS

These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7in spools. 2 Track, $35, 4 Track, $40.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

NEW RANGE OF RESISTORS, CONDENSERS AND POTENTIOMETERS

WE HAVE JUST PURCHASED THE COMPETE STOCK OF RESISTORS, CONDENSERS AND POTS. OF A LARGE MANUFACTURER AND CAN OFFER SAME AT LESS THAN 25 PER CENT OF LIST PRICE.

The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 200 ohm. to 3meg. in ½, 1 & 2watt also included are I.R.C. 3watt wire wound 2,200 ohm. 3,300 ohm 4,700 ohm. etc.
List price **$9.00** per 100 our price **$2.00** per 100 post & packing 25c extra.

The condensers are in most popular makes and include Polyester, Paper, Mica, Ceramic & Electrolytic in standard values including 4mfd, 8mfd, 16mfd 300V etc.
List price **$11.00** per 100 our price **$2.00** per 100 post & packing 30c extra.

The potentiometers are all current types and include switch pots, dual concentric, 1meg. tandem, ½meg switch, tab pots etc.
List price **$12.00** per dozen our price **$2.50** per dozen post & packing 30c extra.

FREE With each lot of resistors, condensers or pots, we will supply free one new valve type 6U7G, 6X5GT, 1T4, 6K7G, or 12AT7. Resistors, condensers and pots are in packs of 100 or 12 and we regret we cannot supply to individual Lists of values or types.

New Hi-Fi Sound Recording Tapes. All Mylar Base.

3" x 150ft	60c
3" x 225ft	75c
2½" x 300ft	85c
3" x 300ft	85c
3½" x 600ft	1.75
5" x 600ft	1.50
5" x 900ft	2.00
7" x 1200ft	3.00
7" x 1800ft	3.75

Post and Packing, 25c extra.

LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Megs. Provision for crystal. Post N.S.W., 75c; Interstate, $1.25.
$34.00

USED HIGH-SPEED 240V. AC/DC MOTORS

These 240v. A.C. or D.C. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle .. .. **$3.75.** Post, N.S.W., 50c; Interstate, 85c.

Switches for Hi-Fi Equipment Etc.

ROTARY SWITCHES and ROCKER SWITCHES

1 Bank 11 x 1 or 5 x 2,, 69c
1 Bank 3 x 3 .. .. 60c
2 Bank 5 x 2 .. .. .. $1.20
Rocker Type D.P., D.T., 50c.
Post and Packaging 15c extra.

NEW BOOKSHELF SPEAKERS

Uses 6" Magnavox Dual Cone Speaker plus 3TC. Tweeter with cross-over condenser.
Dimensions 14" x 8" x 9" deep.

$17.50

Post and Packing Extra.
N.S.W. $1.50.
Interstate $2.00.

THE NEW COLLARO 3-SPEED 4 TRACK TAPE DECKS

$55.00

The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

- 3-speed 1⅞, 3¾, 7½.
- Pause control.
- Takes 7in spools.
- Simplified controls, 4 Tracks, $55. OSC Coils, $1.50.

NEW 4" EXTENSION SPEAKERS

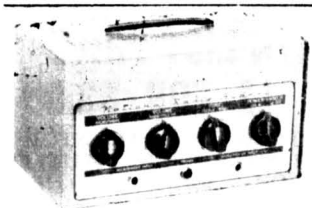
These 4" speakers are mounted in plastic cabinets suitable for use as intercom. units or extension speakers. Fitted with switch and volume control.

SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT $5.00. Post and Packing, N.S.W., 68c. Interstate, 98c.

A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

Using 3 silicon transistors as featured in October Electronics Australia complete with kit of parts including transistors mono **$7.50**, stereo **$13.00**, 240 power supply for above **$7.00.**
Please specify if required for pick-up or tape heads.



25 Watt $59.75
17 Watt $48.75
Post Extra on 17 Watt. N.S.W., $1; Interstate, $1.50
25 Watt by Rail or Air. Too Heavy for Post.

NEW 17 & 25 WATT P.A. AMPLIFIERS

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms. The 25 watt amplifier can be supplied with line output transformers tapped from 100 to 600 ohms if required at $2.00 extra.

Inputs provided for microphones, pick-up, and radio with mixing facilties and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

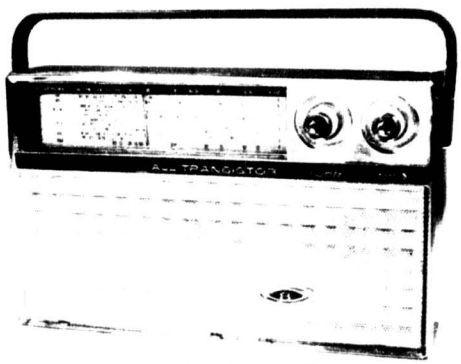
12in speaker for above (10 watt) $7.75
Crystal Microphones for amplifier $5.75

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00



DIMENSIONS
9" x 5" x 3" DEEP

(WIRED AND TESTED $6.00 EXTRA)

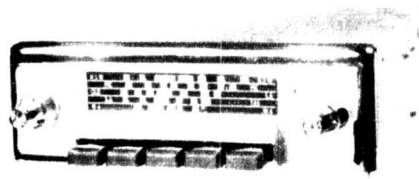
- Complete kit of parts with circuit and full instructions
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all states.
- Available in colours of off-white, red, black or light green.

Post & Packing extra. N.S.W. $1.25, interstate $1.75.

NEW TRANSISTOR CAR RADIO

New transistor six car radios with R.F. stage, of Aust. manufacture using A.W.A. components and transistors.
Available in manual or push-button models with dial calibrated for all Australian States.
Supplied with speaker (5", 6", 5 x 7 " OR 6" x 9") and lock-down aerial.

MANUAL MODEL $43.00
PUSH-BUTTON MODEL $48.00
Post and Packing N.S.W. $1.50, Interstate $2.50.



Suitable for 6 or 12 volts for positive or negative earth. Please state type required.

$23.75

NEW TRANSISTOR SIX PORTABLE KIT AT LESS THAN HALF PRICE

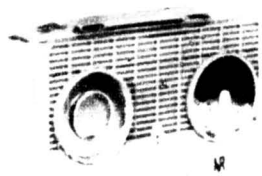
(DESIGNED TO SELL AT OVER $60.00)

Excellent fidelity is obtained in this new kit set by the use of large speaker and polished timber case with attractive gold metal front panel. By using heavy duty batteries it is economical to operate and is ideal for portable use or that second set. Complete kit of parts is supplied with full instructions.

Post and packing N.S.W., $1.25—Interstate, $1.75.

SPECIAL—OFFER

Complete KIT for TRANSISTOR 6 PORTABLE $17.50



The complete kit of parts for the transi stor six includes six transistors, printed circuit board, coil kit. 4in speaker, Ferguson driver and output transformers. heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**
Dials available for all States. Post and Pack: Extra. N.S.W., $1.00. Inter., $1.30.

NEW ENGLISH and AMERICAN TRANSISTORS AT 1/4 LIST PRICE

Ideal for the experimenter or service man.
Each package of 12 contains 3 of each of the following types.

PACKET OF 12 FOR $3.00

Mazda XA101.	Equivalent:	OC45 R.F. Transistor.
Texas 2N1108.	"	OC44 OSC. Transistor.
Texas 2N1111.	"	OC75 General purpose
Texas 2N1110.	"	OC45 R.F. Transistor.

THESE TRANSISTORS CAN BE SUBSTITUTED FOR MANY OTHER TYPES.
Post and Packaging 10c extra.

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TECHNICAL BOOKS AND PUBLICATIONS

CATV systems

CATV SYSTEM ENGINEERING, 2nd Edition by William A. Rheinfelder. Published by TAB Books, Thurmont, Maryland, 1967. Hard covers, 5¼in x 8¼in, 248 pp, many diagrams. Price in U.S.A. $12.95.

The second edition of this rather specialised little volume, the first edition of which was reviewed in the July, 1966, issue. The new edition has been expanded and updated, and can thus lay fair claim to be the most modern and authoritative work in the field of cable-distribution TV systems. Although such systems are as yet used mainly in the U.S.A. and Europe, this should make the book of interest to anyone working in associated applications — such as CCTV, relay and translation, and the installation and maintenance of elaborate VHF aerial and signal distribution systems.

The chapter headings read as follows: The CATV System — Head-End Concepts — CATV Amplifier Characteristics — Cascaded Amplifier Systems — Practical Aspects of Spacing — System Level, Level Diagrams, and Tilt — Disadvantageous Amplifier Design Concepts — Matching and Reflections — High Level Distribution — Amplifier Controls — Automatic CATV Systems — Principles of Cable Powering — Testing CATV Amplifiers. There are seven mathematical and data appendices, a glossary of terms and an index.

Our copy of the book came direct from the publisher, and no information was supplied regarding local price or availability. However it is likely that supplies will be available from local bookstores by the time this review is published. (J.R.)

Electronics, maths

DATA BOOK FOR ELECTRONIC TECHNICIANS AND ENGINEERS. By John D. Lenk. Hard covers, 185 pages, 9in x 6in, illustrated by graphs and tables. Published 1968 by Prentice-Hall Inc. Englewood Cliffs, N.J., U.S.A. Australian price $8.60.

Even though one may have done well at maths in High School and technical college, it is all too easy to forget a great deal of what has been learnt if subsequent employment makes no special call upon it. And, of course, there are always those who learnt enough to scrape through examinations without ever really assimilating and co-ordinating the basic principles.

If any book is likely to repair such a situation, it is this new text by well-known writer John D. Lenk, recently added to the Prentice-Hall series in electronic technology.

Systematically and concisely, the text progresses from a quite elementary revision level in Chapter 1, introducing terms which might have been forgotten and others which are more common to technology than to the classroom. Signs and symbols, exponents and powers, roots and logarithms recall the basis of traditional "arithmetic," and there is similar memory jogging about traditional algebra and traditional trigonometry. The latter, however, leads into angles, vectors and sine curves and the chapter ends with a section on a subject that once received scant attention: binary numbers.

The electronic application of all this begins in chapter 2 with a study of DC circuits, voltage, current, resistance, Ohm's Law, Kirchhoff's Laws, R/C and R/L time constants, conductance and other practical and relevant items such as resistor codes, wire constants and such like. All this at a level well within the capacity of students and technicians.

Chapter 3, predictably, covers AC theory with particular reference to wavelength, frequency, waveform values, resonance and "Q." Mention is made also of admittance, susceptance and conductance; decibels, volume units and nepers, and the configuration of 3-phase circuits.

Inductors and transformer ratios are covered in chapter 4 and capacitors in chapter 5—in both cases quite briefly, with the most important formulas and tables and some connecting text.

In much the same way, the next three chapters deal with "Phase Angle and Impedance Relationships," "Filter Circuits" and "Measurement Calculations and Reference Values"—the latter having to do with meter shunts, multipliers, measurement bridge configurations and such like.

The final chapter, 10, deals with vacuum tubes, calculations for gain and power output, classes of operation and a look at characteristic curves. Strangely, and despite the current year of publication, the author makes no specific mention of transistors.

At the back of the book is a quite lengthy appendix listing: mathematical symbols, electronic symbols and abbreviations, units and their multiples and submultiples, numbers and their powers and roots and logs, abbreviated trig. tables, wire gauges, circuit symbols, decimal/fraction equivalents, drills and taps, sundry other data and, finally, a comprehensive index.

Altogether a most useful book for the student, home-study or otherwise, the serious amateur operator or technician, or the engineer who can use a text with a lot of tables and formulas readily accessible. Our copy came from Prentice-Hall of Australia Pty. Ltd., 242 Pacific Highway, Crow's Nest, 2065. (W.N.W.)

Radio servicing

SERVICE RADIO RECEIVERS, by Leo G. Sands. Stiff paper covers, 175 pages, 8¼in x 5¼in, with photographs and circuits. Published 1968 by TAB Books, Blue Ridge Summit, Pa., U.S.A. Price in Australia $5; for the hard cover edition $8.70.

For the many Australian servicemen who graduated from AM radio to television receivers, this book would be a curiosity indeed. It is written for American servicemen who have spent most of their lives repairing TV receivers and who may now want to take on AM radios as a back-up activity!

With this in view, the author sets out to recall and review the design, operation and malfunctions of such receivers. In so doing, he may provide some assistance to the younger generation of Australian TV servicemen but, equally, the material could be of value to those who are seeking to break into receiver servicing for the first time.

He starts off with a review of AM receiver design through the years, from the old mains-operated TRFs, to AC-DC superhets and on to present-day transistor radios.

Then follow several chapters dealing with troubles that commonly occur in AM receivers, their cause and possible cures: No Reception — Noise and Crosstalk — Hum And Its Causes — Distortion — Intermittent Operation.

This is followed by a chapter on alignment.

Chapter 8 deals with parts replacement — getting the old ones out and selecting suitable new ones. Among the tabulated information in the chapter are the codes commonly used for resistors and capacitors.

Ideas for modifying receivers form the basis for chapter 9, while the final chapter gives a run down of typical test equipment — commercial instruments and servicing aids which can be contrived by the serviceman.

Bearing the insignia of the Gernsback Library, the book shows evidence of the planning and checking that normally characterises the Gernsback series and sample reading revealed no examples of technical error or clumsy phraseology. For anyone seeking to build up a background for radio receiver servicing, this is a really excellent book.

Review copies came direct from the publishers and from Feffer and Simons, Inc., 122 Castlereagh St, Sydney. 2000. (W.N.W.)

TV servicing

PIN POINT TV TROUBLES IN 10 MINUTES. By Harold P. Manly. Stiff paper covers, 372 pages, 8¼in x 5¼in, freely illustrated with photographs, drawings and charts. Published 1967 by TAB Books, Blue Ridge Summit, Pa., U.S.A.

This book was reviewed on page 125 of the August, 1968, issue, from a copy sent direct from the publishers. A further copy has come to hand from Feffer and Simons Inc., 122 Castlereagh Street, Sydney, 2000. Price quoted is $6.25.

Semiconductors

HANDBOOK OF SEMICONDUCTOR CIRCUITS. Published by TAB Books, Blue Ridge Summit, Pa., U.S.A. Hard covers, 6in x 9in, 448 pages, many circuits and diagrams.

This book was reviewed in the July, 1968, issue, from a copy supplied direct from the publisher. A further copy has been received from Feffer and Simons Inc., 122 Castlereagh Street, Sydney, 2000. Price quoted is $10.

Lasers, Masers

LASERS AND MASERS, by Charles A. Pike. Published by W. Foulsham & Co. Ltd., Slough, England, 1967. Hard covers, 6in x 8½in, 176 pp., many diagrams. Price in Australia $5.95.

This book was originally published in the U.S.A. by Howard Sams Inc., as part of the U.S. Navy Electronics Training Series produced under the direction of Training and Retraining, Inc. Written by a practising consultant in the field, it is of the same high standard as other volumes of this series reviewed to date.

The book progresses somewhat more deeply into its subject than one might from past experience be led to expect from its unpretentious external appearance — surely a welcome change. Even more so, it succeeds in presenting its material — both elementary and advanced — in a commendably clear and readable fashion. The text is written in a uniformly concise and methodical manner, following the so-called "programmed text" format in which self-tuitional test questions are given at the end of each topic. In short, the book shows much evidence that it has been conceived and produced with care, skill, and an uncommonly high motivation to communicate.

The chapter headings give a good idea of the subject material and its order of presentation: Introduction to Lasers and Masers — Atomic Structure — Dualistic Nature of the Electron — the Principles of Lasers and Masers — Maser Construction and Operating Characteristics—Laser Construction and Operating Characteristics — Laser and Maser Applications.

An unusually well-prepared book and one which would make a worthwhile introduction to lasers and masers for technicians, university and college students and serious hobbyists.

Our copy came from Grenville Publishing Company Pty. Ltd., who are the local Foulsham-Sams distributors, and who advise that copies are available from all bookstores. (J.R.)

Electrical Text

ELECTRICITY FOR TECHNICIANS by Abraham Marcus. Hard cover, 490 pages, 9in x 6in, freely illustrated by diagrams and photographs. First printing, 1968. Published by Prentice Hall Inc., Inglewood Cliffs, N.J., U.S.A. Price in Australia $11.30.

This new work by Abraham Marcus has all the hall-marks of a quality product, with a clearly defined aim, with well planned and well written text, and very well produced in terms of paper, binding, and print quality.

The author's conviction, as expressed in the preface is that society's present dependence on electricity is no less a revolution than the great industrial upsurge of the eighteenth century. How can any technically inclined person then expect to cope without a basic knowledge of electricity?

Thus motivated, he proceeds carefully and systematically to go through the subject of electricity at "technician" level.

He covers the ground that a technician might be expected to cover and he uses the language appropriate for technicians — developing fact from imparted fact, using illustrations where necessary, avoiding anything in the way of heavy maths, yet including expressions, graphs and formulas of the type that he could reasonably expect technical and secondary school students to take in.

It could, in fact, serve as a very effective text and reference book for students and technicians alike.

The scope and contents of the book is conveyed best by a survey of the major sections, each involving several chapters:

1. What is electricity? (Static and magnetism).
2. Direct Current Electricity (current, its effects, its measurement).
3. Alternating Current Electricity (characteristics, its interaction with L, C and R, its measurement).
4. Sources Of Electrical Energy (mechanical, chemical, solar, atomic, etc.).
5. Transmission and Control Of Electric Power (including 3-phase).
6. Practical Applications Of Electricity (thermal, luminous, chemical, magnetic, mechanical).

In keeping with the publication date, the material is right up to date.

To allow the reader to test his comprehension, a set of examination questions follows at the end of each chapter. And, at the end of the book is an appendix containing sundry relevant symbols, formulas and tables, and a general index.

Our review copy came from Prentice Hall of Australia Pty. Ltd., 242 Pacific Highway, Crow's Nest, N.S.W. 2065. (W.N.W.)

VHF Handbook

VHF HAM RADIO HANDBOOK by Edward G. MacKinnon. Stiff paper cover, 176 pages 8¼in x 5½in. Published by TAB Books, Blue Ridge Summit, P.A., U.S.A. Australian price $5.00.

Apparent purpose of this book is to encourage at least a few American amateurs to pay more atention to the VHF bands, not just with QSOs in view, but the now somewhat neglected art of contriving their own not-too-expensive gear.

The book makes no pretence of being a carefully planned manual on the subject. It is primarily a collection of data and ideas supplied by some thirty-six amateurs, acknowledged only by callsign, and put into some sort of order by the author E. G. MacKinnon.

After a few random (very) hints in Chapter 1, Chapter 2 discusses the peculiarities of VHF propagation, making reference to tropospheric propagation, effects of the aurora and sporadic-E, leading into a discussion of moonbounce transmission and reception.

Chapter 3 suggests some circuit ideas for 6-metre transmitters, a 2-metre final amplifier and a tripler to 432MHz. This leads into Chapter 4 and some ideas for antenna arrays and feeds.

Chapter 5 deals with power supplies, Chapter 6 with modifications to commercial equipment and Chapter 7 with VFOs.

Receivers — or rather, converters — share Chapter 8 with modulators and, in so doing, come off rather poorly. Chapter 9 lists U.S. amateurs who are currently active on the VHF bands while the final section is a collection of sundry circuits.

As we said earlier, this is in no sense a carefully worked out VHF primer but, if you want some ideas and suggestions for not-too-expensive gear, and if you have $5.00 to spare, the book is worth considering. Our review copy came from Ferfer and Simmons Inc., 122 Castlereagh Street, Sydney, 2000 (W.N.W.).

N.A.B. Conference

PROCEEDINGS OF THE 1967 N.A.B. ENGINEERING CONFERENCE, published by TAB Books for the National Association of Broadcasters, Washington, D.C. Soft cover (spiral binding), 9in x 11¼in, 255 p.p., many photographs and diagrams. Price in Australia $12.40.

A volume which should be of particular interest to engineers, technicians and executives in the broadcasting field and associated industries. It comprises a transcript of all the major papers presented at the 21st annual conference of the American National Association of Broadcasters, in 1967, and hence gives the reader a comprehensive and accurate picture of the present state of the broadcasting art.

There are papers dealing on current research into loudness measurement, antenna radiation patterns, new modulation systems, television image processing, and testing techniques; also reports of current production techniques, and descriptions of installations such as colour film processing plant, colour mobile units, and emergency power systems. There are also general discussion papers dealing with such matters as the growing use of microcircuits, and the concepts of automatic broadcasting.

Although the book is intended mainly for technical people working in the field most of the individual papers are written in a straightforward fashion without excessive use of specialised terms and concepts, and could be read fairly easily and profitably by a general technical reader. The book would thus provide practical reading for both hobbyists and students, as a means of gaining insight into modern practice in radio and TV broadcasting.

Two copies came our way for review, one coming directly from the publisher in the U.S.A., and the other from their representatives in Australia Feffer and Simons, Inc. We understand that copies are available already at most local bookstores. (J.R.)

LITERATURE—in brief

MANUFACTURERS SPECIAL PRODUCTS PTY. LTD. has published a leaflet describing the company's range of "Hi-Flux" speakers. It lists miniature, round and elliptical speakers, speakers with wide-range twin cones, speakers for low, mid or high frequencies, and car radio replacement speakers. Also available is a leaflet describing the M.S.P. range of audio transformers, both potted and open, and including transistor driver transformers. Inquiries to the company at 47 York Street, Sydney, N.S.W. 2000.

UNIVERSITY LABORATORIES, 733 Allston Way, Berkeley, California 94710, U.S.A., has published a 4-page brochure on continuous gas lasers and accessories. Six helium-neon lasers are described with output powers between 10mW and 0.6mW. Each laser incorporates a proprietary plasma tube, designated a Lasertron tube, which has permanently adjusted internal mirrors. It is described in the literature as "the world's only coherent light bulb." Inquiries to the company's marketing manager at the address above.

COMPONENTS REVIEW, Vol. 5, No. 3, June/July, 1968, the new products guide published by Standard Telephones and Cables Pty. Ltd., includes descriptions of the following products: polycarbonate capacitors; miniature rotary switch for printed board mounting; packaged bridge rectifiers; Epocor Pack No. 1 selection of copper clad laminate; Decade counter and display using integrated circuits; vacuum relays; 3-phase vacuum contactor; selenium surge suppressors; STC transistors; silicon rectifier BY147; Silicon NPN transistors BD106A and BD106B. Inquiries to the company at Moorebank Avenue, Liverpool, N.S.W. 2170.

LITERATURE—in brief

MEASURETEST, No. 7, published by Marconi Instruments Ltd., St. Albans, England, includes the following articles: New Version of White Noise Test Set; A Current Probe Standardising Source; Safety Circuit for 500MHz Converter; Differential DC Voltmeter. Inquiries regarding this publication or about "Contact" — the international news bulletin of Marconi Instruments — should be addressed to Amalgamated Wireless (A'asia) Ltd., Mail Point 23, P.O. Box 96, Ryde, N.S.W. 2112.

BREAK-IN, Vol. XLI, No. 5, June, 1968, the official journal of the New Zealand Association of Radio Transmitters Inc., is the Call Book for 1968. It lists the call signs for all transmitting members and lists all non-transmitting members, junior members and associate and overseas members. Other items in this number of the journal are a world zones map, prefixes by countries, standard frequency transmissions, and amateur frequency allocations. Break-In is published monthly for an annual subscription of $3.50. Inquiries to Box 1733, Christchurch, N.Z.

S.F.D. LABORATORIES INC., a Varian subsidiary, of Union, New Jersey, U.S.A., has published a short-form catalogue "Advanced Microwave Tubes for Advanced Systems" which describes the company's current lines of coaxial magnetrons and crossed-field amplifiers. The booklet also describes the company's ability to provide complete amplifier chains using S.F.D. Laboratories crossed-field amplifiers with Varian travelling wave tubes. Trade inquiries to Varian Pty. Ltd., 38 Oxley Street, Crow's Nest, N.S.W. 2065.

RADIOTRONICS, Vol. 33, No. 2, May, 1968, includes the following articles: 2 Watt Complementary Output Audio Amplifier; AS60—AS63 Controlled Avalanche Rectifiers; Application of SCRs to the Control of Universal Motors; News and New Products; 17ERP4 Picture Tube; Photo-conductive Cells; AS204, AS205, AS208, AS209 Silicon Transistors. Radiotronics is published quarterly at a cost of 50c per copy and is available from the Sales Department, Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, Ermington, N.S.W. 2115.

VARIAN ASSOCIATES Vacuum Division has published a second edition of its booklet "General Characteristics of Titanium Sublimation Pumps." This includes the operating principles of titanium sublimation pumping along with calculations, new design data, and discussion of the benefits of this system. Several new graphs and illustrations appear in this edition. Trade inquiries should be addressed to the Australian company, Varian Pty. Ltd , 38 Oxley Street, Crow's Nest, N.S.W. 2065.

DUCON DIVISION, Plessey Components Group, has published technical bulletins describing the following products: epoxy coated polyester capacitors type DMA; silvered mica capacitors type MSA; ceramic disc capacitors type CDR "Redcaps"; miniature ceramic disc capacitors type CDM; miniature ceramic feed-through capacitors type CAC110; Ducon RTC series potentiometers; thermistors type A/T and A/To; Votabloc nickel-cadmium cells series VR and VB. Inquiries (on company leterhead) to Ducon Division, Box 2, P.O., Villawood, N.S.W. 2163.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD., has published a Picture Tube Interchangeability Chart. This lists about 200 TV picture tubes with suitable replacement types. Notes are given for guidance where the alternate tube is not identical in all respects. Twelve AWV tubes are given as universal replacement tubes for at least 125 popular picture tube types. Inquiries to the company at Private Mail Bag, Ermington, N.S.W. 2115.

EDUCATIONAL ELECTRONIC KIT

The firm of Broadway Electronics is marketing an electronic kit for those seeking an elementary knowledge of the subject. Some 20 projects may be constructed from it, without the use of tools or soldering iron.

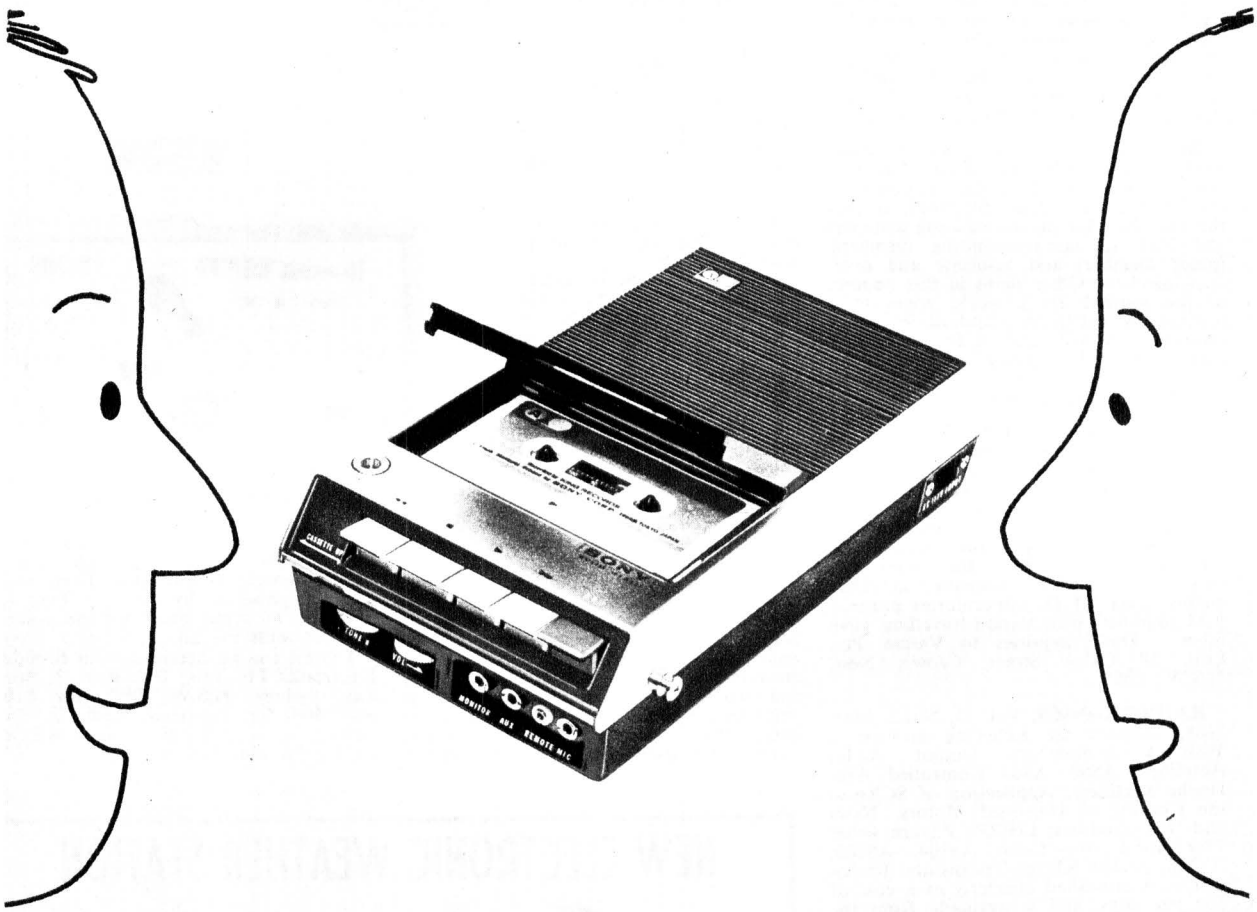
The Instrol Educational Electronic Kit is designed to allow novices, both young and old, to understand the basic principles involved in electronics by building simple circuits, all of which are designed to work. The kit is supplied complete with an instruction manual and all components necessary for the projects presented.

Each component is mounted on a small insulated panel which fits onto a circuit mounting board. The kit includes tuning coils, tuning capacitor, two transistors, a diode, resistors, capacitors, coupling transformer, volume control, Morse key, microphone, earphone, and a solar cell. No soldering is required, as all connections are made by clip-on connecting leads supplied in various lengths.

The 50-page manual describes how to assemble and connect each of 20 different projects, with a simple circuit description in each case. The manual also gives some definitions and elementary theory to help a novice to appreciate something of what is happening in the circuits. The projects presented include crystal sets, one and two transistor radios, basic transistor amplifiers, a short wave radio, RF oscillator, Morse code practice set, signal tracer, AF oscillator, intercom system, wireless microphone, and simple transmitter. (The last two projects may be legally dubious in Australia). Each project can be powered by one or two 1.5V cells, or in some cases by the solarcell supplied with the kit.

The kit can be obtained from Broadway Electronics Pty. Ltd., P.O. Box 43, Broadway, Sydney, N.S.W. 2007, for $16.90 plus 60c for registered post. A loudspeaker kit is available to work with this kit for $6 plus 10c postage.

Model illustrated: TC100. list price $150.



It's a what?
It's a SONY Cassette-Corder
I see.....a **what?**

Let me explain. Sony is always at least a year ahead of everyone else. They created Japan's first transistor, for example, and transistor radio. The first tape recorder; the first video recorder. And now here's something new. Sony call it a Cassette-Corder. It combines all the advantages of the cassette tape system (no threading, no adjusting reels, no loading or unloading). And 60 minutes recording capacity. Plus mains or flashlight battery operation. Plus 1-watt power and high-frequency response. Plus the versatility of being a dictating machine . . . a note-book . . . a musical instrument. The Cassette-Corder is an electronic miracle. *That's* what it is. *Optional extra: C-90, 90-minute cassette.*

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Please send, without obligation or cost, information on Sony Tape Recorders.

NAME .....

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.....

P'CODE .....

3.S46/EA/9

L, C & R CIRCULAR CALCULATORS

We have recently had the opportunity to examine two small circular calculators designed to perform quickly various electronic circuit calculations which have hitherto been tedious and time consuming. Of Australian manufacture, they are known as Zodix Calculators No. 1 and No. 2.

Zodix Calculator No. 1 performs two types of calculation. On one side it determines the impedance of a circuit containing resistance and reactance in series (the three sides of a right-angled triangle).

The procedure is simply to set resistance and reactance on the appropriate scales and read impedance. A cursor enables accuracy to three significant figures to be obtained (normal slide rule accuracy). Any two of the above parameters may be known and the third determined.

The reverse side of No. 1 Calculator determines the impedance of a circuit containing resistance and reactance in parallel. Operation is similar to that described above.

Zodix Calculator No. 2 also performs two types of calculation. On one side it determines the effective resistance of any number of resistors in parallel (or the effective capacitance of any number of capacitors in series). The values are simply set off on the scales and the answer read off under the cursor.

The reverse side of No. 2 Calculator determines the reactance of either an inductor or capacitor at any frequency. Inductors from .01mH to 100H and capacitors from 100pF to 1000uF are catered for. Frequencies from 10Hz to 100MHz and reactances from 1 ohm to 10 megohms are included.

The scales are hot stamped in black on white plastic and will not rub off with use. A cursor enables scale settings to be made quickly and accurately. Each unit comes complete with detailed instruction leaflet and pocket-size plastic pouch.

The samples submitted to us were robust, well made units, which should stand up well to the normal wear and tear of workshop use. They should appeal to experimenters, students, engineers, etc., as a useful, time-saving, device.

The calculators cost $2 each, post free in Australia and New Zealand, and may be obtained from Zodix Calculators, P.O. Box 141, Balgowlah, N.S.W. 2093.

LITERATURE—continued

TELECOMMUNICATION JOURNAL, Vol. 35, No. 7, July, 1968, is devoted to the program of technical co-operation being carried out by the International Telecommunication Union (I.T.U.). An article by E. D. Schmidt describes a telecommunication plan for Paraguay; a second by H. Ruud discusses network projects in developing regions; and an article by N. Komplita describes the problems encountered in the recruitment of technical assistance experts. There is also a seven-page report by the I.T.U. on technical co-operation in telecommunications in 1967. A further article by N. Joachim and C. Glinz describes a method of predicting the ionospheric propagation index.

In its "Ideas and Achievements" feature is published information on the first permanent satellite earth stations in South-East Asia, the first European-built satellite (ESRO-11-B) and telecommunications in the Republic of the Niger. Telecommunication Journal (in separate editions in English, French and Spanish) may be obtained from the Publications Service, International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland, for an annual subscription of 25 Swiss francs per language (single copies 2.50 Swiss francs.)

INDUSTRIAL RESEARCH NEWS, No. 70, July, 1968, has the following items: Millions of cobalt pellets made annually; Terrain evaluation; Drawing by computer; Interferometer; Glazed concrete; Leaf planimeter. Industrial Research News is produced bi-monthly by the Industrial and Physical Sciences Branch, Commonwealth Scientific and Industrial Research Organisation, 314 Albert Street, East Melbourne, Vic. 3002.

NEW ELECTRONIC INSTRUMENTATION, Spring, 1968, has been published by Hewlett-Packard to keep customers informed of new products introduced in the spring of 1968. These include analysers, calibrators, converters, counters, data acquisition system, digital computer, frequency standard, oscilloscopes, oscillators, power supplies, recorders, test sets, signal generators and various components, semiconductors and accessories. Inquiries, on company letterhead, to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria. 3146.

THE WEATHER MAP AND HOW TO READ IT is a 16-page pamphlet prepared by (and available from) the Bureau of Meteorology for those who are not only interested in what is going to happen to the weather, but also why it is going to happen. The pamphlet was designed to answer some of the more common queries about the weather map and to help people to interpret it. Inquiries to the Bureau in State capital cities.

STC COMPONENTS REVIEW, Vol. 5, No. 2 (March, 1968) has articles describing the following products: Ceramic IF Filters type EFC-D455; Silicon Avalanche Power Diode Rectifier Assemblies; Polycarbonate Capacitors; Silicon Avalanche Rectifiers; ITT High Capacitance Electrolytic Capacitors; TT Series Silicon Epitaxial Planar Transistors; EM400 Series Silicon Power Rectifiers; and, Special Quality Valves at reduced cost. Components Review is published by Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool N.S.W. 2170.

TUDOR RADIO

L. E. CHAPMAN
ESTABLISHED 1940

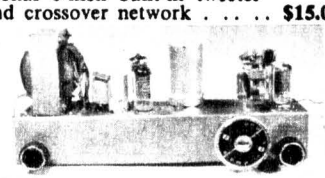
103 ENMORE ROAD, ENMORE, N.S.W.

PHONE 51-1011 **PHONE 51-1011**

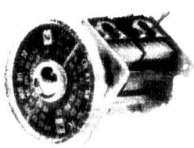
Knobs long shaft, push on. Dozen **$1.20**
Knobs for concentric shaft. Dozen **$1.20**
250 mixed screws. BA, Whit., self-tapper bolts, nuts, etc. **$1** bag plus **25c** post.
Crystal microphones, good quality, ideal tape recorders, etc. **$2.80.**
Transistor speaker transformers, single ended, 5 watt. **$1.50.**
Dutch Philips 3 pin flexible jacks, **40c** each.

SPEAKERS

MSP 8-inch dual cone	$5.80
MSP 12-inch dual cone	$7.50
MSP 7 x 5 3R 15ohm	$3.50
MSP 3½-inch 3 ohm	$2.00
Rola 6 x 4 15 omh	$3.00
Rola 5 x 3 15 or 27ohm	$2.00
Rola 5B 3ohm	$2.00
MSP 6 x 9 15ohm	$5.00
3-inch single cone 15ohm	$4.20
6 x 4 33ohm	$3.00
MSP 20 Watt	$19.75
MSP 12-inch 8ohm	$7.00
MSP 2-inch 15 ohm	$2.00
MSP 8-inch dual cone 8ohm	$5.80
MSP 12-inch 3.5ohm	$6.00
MSP 4-inch large magnet 8ohm	$2.50
MSP 3-inch 150ohm	$3.00
National 8-inch built-in tweeter and crossover network	$15.00



RADIOGRAM CHASSIS 4 valve including valves and speaker, $15.50. Size 10¼ x 3 x 5.

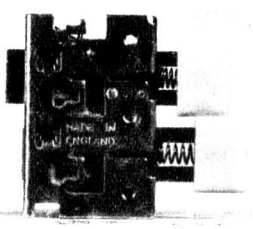


SMALL 2-GANG TUNING CONDENSERS
Complete with direct drive scale. **$1.75**

NEW GRAMOPHONE MOTORS, For 4-speed Turntables .. **$2.50** each.

TV IF STRIPS .. .. **$5** each.

ENGLISH PANEL LAMP with toggle switch **75 cents.**



English push-button on/off switches, **75c each. Pack and post 10c.**

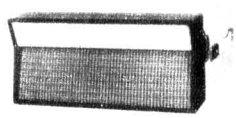
Vinyl insulating tubing, 13MM wall thickness .030, 25 yards .. **$1**

Mini cable, 4 strand shielded, lots of uses, including microphone cable, extension speakers etc. ..... **10c** yard
Radio knobs, push on .... **50c** doz.
Miniature valve sockets 7 and 9 pin **15 cents** each.
Picture tubes, all sizes, new in cartons. **$25.00.** With your dud. Bonded extra.
Philips IFT's 455KC ..... **75c** each
Aerial and oscillator coils .. **50c** each

Scope soldering iron, standard; mini scope. Scope De Luxe. Vibra scope; National scope transformer.

Transistor IFs, medium size, **75c** each

Record Changers. Garrard AT 60.



PORTABLE RADIOGRAM CASES. NEW, SHOPSOILED **$4**
Pack and Post, 50 cents.

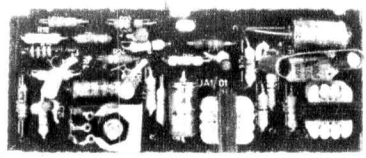
Transistor speaker and drive transformers, large and midget type .. **$1.00**
Speaker transformers 15,000 and 25,000 to 3 ohms 6 watts .... **$1.50** each
5,000 to 3 and 15 ohms .. **$1.25** each
Transistor speaker chokes .. **$1.50** each

Here's value in pots.

Pots, single log and linear:
3K, 7½K, 10K, W.W., 20K, 25K, 50K, 100K, 200K, 250K, 500K, 1 Meg, 2 Meg. Dual Concentric Switch Pot **$1.25**
Pots 25,000 dual gauged switch pots, **$1.25**
1.5 Meg. Dual Concentric .. **$1.00**
Pots dual ganged 10K, **50c.** 1 Meg. **$1.25**
Pots concentric. 100K + 50K, 100K + 2½K, 100K + 10K, 250K + 250K, 500K + 500K, 1 Meg + 1 Meg., 1 Meg. + 500K. Various others **50c** each
TV power Transformers 300 mill 225v a side, suit amplifiers up to 50 watts voltage doublers available, **$8.00** each
TV safety glass per sheet ... **$3.50**
Garrard plug in stereo heads **$4.00**
TV masks, 17, 21, 23in .... **$1.50** each
Tuning condensers 2 and 3 gang, **$1.00**

STEREO AMPLIFIER KIT SETS

TU 10, 3.5 watt per channel . . . **$19**
TU 11, 3.5 watt per channel, has facilities for tape and microphone channels **$23**
TU 12, 5 watt per channel **$22.00**
TU 13, 5 watt per channel, with TU 11 facilities **$27**
Each kit set includes valves and all components. Front face plate, if required, $1 extra.
Single stage amplifier kit set: 5 watt per channel **$22.00**
Transistor ear plugs .... **3 for $1.00**
Tag strips, mixed types .. **Dozen, 60c**
Switches, oak 4 position .. **50c** each
2 position ..... **40c** each

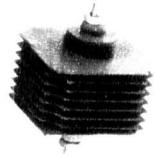


TRANSISTOR AMPLIFER, well known make, 1 watt output. **$8**

ELECTROS:

3 in one		
50	250	415
8	350	415
10	350	415

75 cents each.



Metal Rectifier .. .. **$1 each**

TV AERIALS

Famous Make
All types $3.50 to $20.00 plus post.
TV aerial lead in ..... **8c** yard
TV aerial chimney mount kits .. **$3.50**
Wall stand-off brackets, pair .. **$1.90**

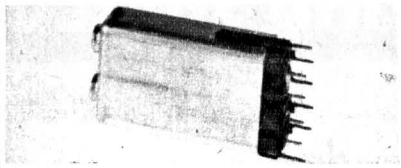
2 amp fuses ..... **$3.50 per 100**
Special, 12in speaker, 2 ohm Rola, **$6.00** pack and post, **75c.**
Transistor plastic outer case, **50c** each
Transistor carrying straps .. **20c** each
Stereo pick-up arms, with Xtal, **$6.00** ea.
Metal rectifiers for battery and electric portables ..... **50c** each, post. **10c**
Pilot lamp holders ..... **30c per doz.**
TV or cabinet castors .... **4 for $1.00**
100 Mixed Knobs including TV channel changers **$10.00**
240v AC Record Changers, stereo **$21.50,** Mono **$20.00.** Pack and post, N.S.W. **$1.50,** interstate **$2.50.**
Gramophone motor and pick-up, 240v AC **$11.50.** Pack and post, N.S.W. **$1.00,** interstate **$1.50.**
OA 70 diodes ..... **40c** each
Morganite and IRC resistors. At least 33 values. Suit transistors, radios, TV, etc., **$2.00 per 100.** Pack and post, **25c.**
3, 5, and 10 Watt IRC wire wound resistors. Many values.
20c each, **12 for $2.00**
100 mixed condensers, micas, ceramics, tubular. Fresh stock.
$2.00. Pack and post **25c.**
50 + 24, 350 vw + 100 mf 25vw, **75c** each
30, 30mf 300 vw 350vp .. **75c** each
Many others. Invaluable for service.

SHEPHERD CASTORS, **$3.00 set of 4.**
SMALL AMPLIFIER OR TUNER CHASSIS, **$1.50** each. Pack and post **25c.**
ALPHA 200VAC ½ amp push-on switches, **30c** each. Ideal for fridges.
90 deg. PICTURE TUBE SOCKETS **25c** each. 152 valve sockets, **25c** each.
Transistors AC127, 2N384, 2N217, 2N218, OC71, OC75.
$1.00 each. Post and pack **5c.**

NEW VALVES

12AU7	$1.25	12BE6	$1.00
6SA7	$1.25	6AU4	$1.25
6BU8	$1.25	6U9	$1.25
6M5	$1.25	6Y9	$1.25
6AN7	$1.25	6X9	$1.25
6N8	$1.25	6AQ5	$1.25
6BM8	$1.50	1B3	$1.50
1S5	$1.00	1S2	$1.50
1T4	.50	5AS4	$1.25
6CJ6	$1.50	6DQ6	$1.50
6L18	$1.00	12AT7	$1.25
ECL85	$1.25	12AX7	$1.75
SP61	$1.00	6B8	$1.25
UU9	$1.00		

THREE WATT AMPLIFIERS, complete with speaker. **NEW. $10.00**



TV IF Coils, ideal for Coil Formers .. .. **$1 dozen.**

10MFD 25 WKG 40 volt surge .. 20c

Electros 1.8 x 0 9 MF — 20c each

¼ and ½ AMP. FUSES **$3.50** 100.

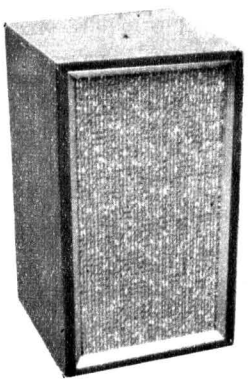
1000MFD 10 VOLT CONDENSERS, 40 CENTS EACH.

AUDIO TRANSFORMERS
18-4294, 28-4536 .. .. **75 cents** each.

PILOT LIGHTS, Plug in .. 10 cents

SWITCH WAFERS
20 Cents each.

VICTOR 16MM FILM PROJECTOR
110 Volt **$90** without Stepdown Transformer.



SPEAKER CABINETS
13 x 6¾ **$5.00**
10 x 6½ x 4½ **$3.50**
12½ x 8¾ x 6 ..... **$5.00**

TWO-GANG TUNING CONDENSER.
Stromberg Carlson **50c**

Dial drums 5 inch, 3½, 3¾ .. 50c each

National speakers 8 inch built-in Tweeter, Crossover net work. $15
10 inch Bass, mid range Tweeter combined. $32

Fuse holders ..... 50 cents doz.
Octal valve sockets .... 50 cents dozen
Chokes 18 Henry 30 mil. **$1.50**

ELECTROS 20 MFD 200 PV — 20c

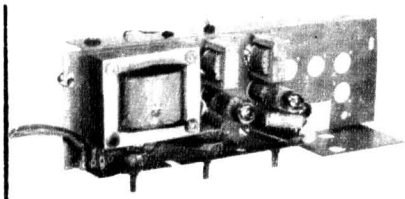
RESIN CORE SOLDER 5 yards 75c

STROMBERG - CARLSON 23in TV chassis, 3 parts, complete **$20.00**

M.S.P. 6in SPEAKERS, 3 or 15ohm **$4.00**

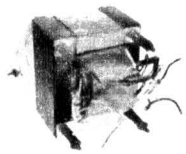
6 VOLT PILOT LIGHT, screw-in .. .. **ea. .10**

TRANSISTOR speaker and Case Plastic 5-inch speaker with plug and lead, **$4** each. Pack and Post 25 cents.

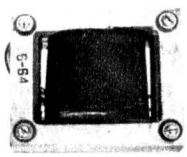


STEREO AMPLIFIER, 3½ watts per channel **$19**

TV Portable voltage doubler power trans. C. Core. 240 volt 77V 1 amp. 6.3 Volts 8 amps, **$6.**



TV POWER TRANSFORMER, $8. 300 mil. Two 6.3 windings. 200 volt secondary for Bridge Type Rectifier.



POWER TRANSFORMER
240 volt 285 a side 6.3 75 mil. **$3.50.**

SPECIALS

TRANSISTOR AUDIO TRANSFORMERS, medium size .. **75c** each
PHILIPS GRAMOPHONE MOTOR. 4-speed. New. 6-volt **$5.00**
Pack and post, 10c.
TRANSISTOR OUTPUT AND DRIVE TRANSFORMERS. Medium size, **$1.50** pair.
Pack and post, 10c.
SPEAKER TRANSFORMERS, 5,000 to 8 ohms 10 watt ..... **$1.90** each
Pack and post, 20c.
DYNAMIC MICROPHONES, good quality **$7.50**
8-STRAND WIRE ONE SHIELDER, 20c per yard.
CARAVAN TV AERIALS .. $10.50
SILICON DIODES 210 3254G HR15, **75c** each
CAR RADIOS, new push-button transistor 8 ..... **$50.00**
Pack and post, **50c.**
CABINET CLOTH, best quality, **50c** sq. ft.
TV CABINETS, 19 SLIMLINE, with screw-on legs. Brand-new and polished maple, packed in original cartons. Ideal for speaker enclosures, etc. **$10.00**
ELECTROLYTIC CAPACITORS. 20, 400, 450, 10, 400, 450 ..... **$1.50**
50, 65 ..... **50c** each
Pack and post, 10c.
500, 10VW, 12VP **30c**
400 MFD, 10V **30c**
00.5MFD, 2000 DD.CW HERMSCEAL, **20c**
TRANSISTOR SPEAKER TRANSFORMERS, 500 to 30 ohm **50c**
Pack and post, 10c.
TRANSISTOR CHOKES, 2 ohm **50c**
Pack and post, 10c.

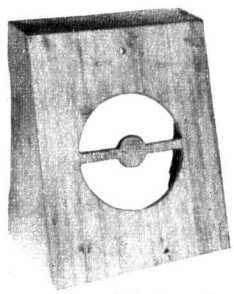
NEW RADIOGRAM, chassis, mono, complete, valves, speaker **$13.50**

GARRARD, 32 volt, 3 speed record changer **$15**

TRANSISTOR 8 RADIOGRAM CHASSIS
Complete except pots and Ferrite Aerial. Famous make. **$18**

STEREO SPEAKER LEAD, 8 Cents yd.

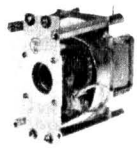
2 ONLY, TRADED-IN AMPLIFIERS.
4 Watts for Channel ..... $16 each.



Speaker box unpolished suit 8 inch speaker $3.75. Pack and post 50 cents.

GARRARD MAGAZINE TAPE DECK
¼ Per Second, 2 Track, Left to Right **$25.**

PHILIPS BEETHOVEN MODEL 180
7-Valve Dual-wave Radiogram. Complete with conversion to Stereo Amplifier **$60**
2N 1108, 2N 1110, 2N 1111, Transistors **50 Cents** each.



RCA VIBRATING CAPACITOR.
98601 .. .. **$2**

STEREOGRAM CHASSIS VALVES.
Complete except speakers **$25.00**
Pack and post, $1.50.

Dial scales, 5in 11½ x 6, 10½, 3½, 9¾ x ¾ **50c**

Pots 50 ohm switch, ... 50 cents each.

American or Japanese 2 pin power plugs rubber complete with 2½ yards flex 50 cents, Pack and post 10 cents.

Microphones magnetic or crystal $1.75. Pack and post 10 cents.

New pocket size transistor 6 radios in presentation case $20.00.

Magnavox GWR, 8 WR, 10 WR, 12 WR. Tweeter 3, 4 or 5 inch

Speaker Plugs, 4 pin .. .. .. 15 cents
Speaker Sockets .. .. 15 cents

PUSH PULL AUDIO TRANSFORMERS 10,000 CT 3.5 ohm .. **$3.00** each

STEREO HEADPHONES, $10 pair. Pack and post 25 cents.

TRANSISTOR DRIVE and **OUTPUT TRANSFORMER** 23 to 15 ohm. **75** cents a pair.

Size 5 x 6 x 3 TRANSISTOR speakers in Cabinet wood polished $4 each. Complete with plug and lead. PACK and POST 25 cents.

Mullard Bookshelf Speaker Cabinets **$10** each.

AMATEUR BAND NEWS AND NOTES

Space Communication Channels on I.T.U. Agenda

An International Telecommunication Union Conference on Space Radio Communication is to be convened late in 1970 or early in 1971.

By Pierce Healy, VK2APQ*

Throughout the world amateur radio operators are showing more interest in I.T.U. deliberations relating to radio communication services. They are also becoming increasingly aware of the effect that these conferences could have on amateur service frequency allocations. While all conferences do not deal with portions of the radio frequency spectrum wherein the amateur bands are located, side effects of decisions made in regard to other services could affect the amateur service.

The amateur service, being progressive, is interested in space radio communication, as has been proved by the OSCAR and AUSTRALIS projects. In this regard carefully consider the "mights" in the proposed agenda items for the 1970-1971 conference.

It could be asked what might happen if the I.T.U. is disregarded as indicated in Resolution 637. If the I.T.U. is concerned should not the amateur service be concerned? Also, where will the amateur service stand if international organisation breaks down? A better understanding of these points will be gained by studying the fundamental purposes of the I.T.U. as outlined.

Generally speaking, however, the amateur does not spend time delving into the background of I.T.U. administrative matters to see what might affect his activities on the air. He is satisfied to accept what he occasionally hears. This attitude certainly breeds an apathetic approach towards such matters. Then, when something happens to curtail what he considers are the rights of the amateur service, he becomes critical of administrative bodies and even his own amateur radio societies. It is with this in mind that more detail than usual is included in these notes.

It could be said that the information contained in this article has no direct bearing on amateur radio. This may eventually be the case; it is certainly hoped so. However, it is recommended that some thought be given to what might happen, and having done so realise that some real support should be given to local amateur radio societies, just in case something unexpected does eventuate.

References to resolutions and regulations are made to indicate the authoritative source for the information given, and to assist those who, after thinking about the possibilities, would like to go deeper into the subject to have an official reference point from which to commence.

In discussing the activities of the I.T.U. the function of several of the internal working groups of the Union are summarised. An appreciation of the complexities of space communication systems from the allocation of frequencies, propagation, interference problems and the location of satellites will be obtained from the details given. It will also give some food for thought, not only on the effect the deliberations may have on the amateur service but, also, for the amateur who likes to keep up with modern communication techniques.

A recent Press release from the International Telecommunication Union refers to action by the Administrative Council with regard to Space Radiocommunications. This says:

"At the 23rd session of the Administrative Council of the I.T.U., held at headquarters in Geneva from the 11th to 31st May 1968, the council adopted some important resolutions, in particular on the role of the Union in space telecommunications and the convening of a conference on space radiocommunications at the end of 1970 or the beginning of 1971."

As annexe to the press release were reprints of two resolutions on space telecommunications. Resolution number 632 refers to: a recommendation of the Extraordinary Conference to allocate frequency bands for Space Radio Communication Purposes, Geneva 1963; The substantial progress in the field of space telecommunications achieved since the 1963 conference; and, in view of the studies made by the International Frequency Registration Board and the interest of many international organisations in space telecommunications, the need to revise the Radio Regulations relating to telecommunications.

The resolution recommends to Administrations that a World Administrative Radio Conference be convened during the latter part of 1970 or early 1971 with an approximate duration of five weeks and with an agenda to include in particular the following items:—

1. To revise existing administrative and technical regulations and adopt such new provisions as are necessary for the space radio services and the radio astronomy service which will ensure the efficient use of the spectrum.

2. To consider, and revise as necessary, the provisions of the Radio Regulations pertaining to the Aeronautical Mobile and Maritime Mobile services and to navigation in so far as the use of space techniques is concerned.

3. To consider and provide, as far as possible, additional radio frequency allocations for the space radio services.

4. To revise and supplement as appropriate the existing technical criteria for frequency sharing between space and terrestrial systems and establish criteria for sharing between satellite systems.

Resolution number 637 refers to the role of the I.T.U. in space telecommunications. It also notes that various international organisations interested in the applications of space telecommunications are tending to overlook the role of the I.T.U. in the study and regulation of the technical and operational aspects of space telecommunication.

The fundamental purposes of the Union, as outlined in its basic instrument, are:

a. To maintain and extend international co-operation for the improvement and rational use of telecommunications of all kinds.

b. To promote the development of technical facilities and their most efficient operation with the view to improving the efficiency of telecommunication services, increasing their usefulness and making them, as far as possible, generally available to the public.

c. To harmonise the actions of nations in the attainment of these common ends.

The resolution also points out that space telecommunication is merely another form of the art of telecommunication involving the I.T.U. in its traditional responsibilities. That the I.T.U., through its administrative conferences and its permanent organs — the International Radio Consultative Committee (C.C.I.R.); the International Telephone and Telegraph Consultative Committee (C.C.I.T.T.); and the International Frequency Registration Board (I.F.R.B.) — is fully qualified and well equipped to deal with the study and regulation of the technical and operational aspects of space telecommunication.

The resolution instructs the Secretary-General to bring to the notice of the Secretary-General of the United Nations, to the heads of the U.N. Specialised Agencies, and to all international organisations known to have an interest in any aspect of space telecommunications, details of these two resolutions and to ask all such international organisations to:

a. Keep the Union informed about any discussions or developments concerned with space telecommunications which they propose to initiate and which may touch upon the Union's sphere of interest.

b. Where appropriate and to the extent that their constitutions permit, to invite the I.T.U. to be represented at any meetings they may convene on subjects involving space telecommunication.

An annex to resolution number R637 relates some of the decisions and work of the permanent organs of the I.T.U. mentioned above. Some of the points mentioned are:

The I.F.R.B. In its Resolution No. 1A, relating to the provision and use of information regarding international satellite systems, and Administrative Space Radio Conference, Geneva, 1963, resolved that any administration or group of administrations which intended to establish an international satellite system should provide the Board with a general description of it. The Board was instructed to publish this description so as to enable any other administration which believes it has reason to expect harmful interference to address its comments to the

*** News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W., 2200.**

administration concerned. The latter should then endeavour to find a satisfactory solution and the Board might be asked to submit suggestions if necessary.

This procedure, which in no way resembles the procedure for the recording of the Master International Frequency Register of frequency assignments to stations of the space service, has been applied so far to four international satellite systems, the description of which has been brought to the notice of Administrations.

Under Resolution No. 165 of the International Telecommunication Convention, one of the essential duties of the I.F.R.B. is to effect an orderly recording of frequency assignments made by different countries.

So far as terrestrial stations are concerned, the rule given in Article 9 of the Radio Regulations is that, except in certain specified frequency bands allotted on a regional basis, all frequency notices shall be examined by the I.F.R.B. with respect to the probability that harmful interference may be caused to stations in any service by use of the notified frequency.

In the case of the space service, all assignments of transmitting or receiving frequencies to an earth station notified in accordance with Article 9A of the Radio Regulations are examined by the I.F.R.B. with respect to the site of the station concerned in relation to the frontiers of the notifying country. It depends on the result of this examination, which is based on the notion of "co-ordination distance" defined by the Administrative Space Radio Conference in 1963, whether or not the notifying Administration is asked to make a closer study, in co-operation with the Administration of the neighbouring country or countries, of the probability of harmful interference between the earth station and the stations in terrestrial services of the latter country or countries and to co-ordinate the use of the frequencies with the latter Administration(s).

With regard to frequency assignments to space transmitting stations notified under Article 9A of the Radio Regulations, the I.F.R.B. studies them — when they concern frequency bands shared with terrestrial services — by calculating the power flux density produced at the earth's surface basing itself on the emitted power, the antenna characteristics and orbit characteristics. The board gives its opinion on the frequency notices after comparing the results of its study with the established criteria.

A frequency assignment to a space receiving station notified in accordance with Article 9A does not undergo technical examination by the I.F.R.B. It is for the notifying Administration to take necessary steps to ensure that such a receiving station is not subject to interference either from emissions by other stations of the space service or, should it be operated in a frequency band not allocated exclusively to the space service, from emissions by terrestrial stations.

Frequency assignments to stations of terrestial services in the frequency bands shared by those services with space receiving stations, are examined by the I.F.R.B., which compares the maximum effective radiated power with the established criteria.

THE C.C.I.R.

The C.C.I.R. has concerned itself with space communications since 1959 when a Study Group was set up to deal especially with the problems of space telecommunications to provide a sound technical basis for the most efficient use of the radio-frequency spectrum. The latest C.C.I.R. texts on this subject, which include studies of the technical and operating aspects of all forms of space telecommunications, are principally prepared by Study Group TV, space systems and radioastronomy, and approved by the 11th Plenary Assembly of the C.C.I.R. in Oslo June/July, 1966. These studies concern the possibilities of communication satellites per se and those connected with the

RADIO HOUSE PTY. LTD.

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NEW MODELS 'KAISE'

Volt, Ohm, Milliamp Meters, all with overload protection and mirror scale and test leads and instructions.

Model 55	$20	30,000 o.p.v.
Model 60	$25	50,000 o.p.v.
Model 70	$22.50	30,000 o.p.v.
Model 80	$18	20,000 o.p.v.

Postage extra 50c.

Double jewelled 2% ± meter
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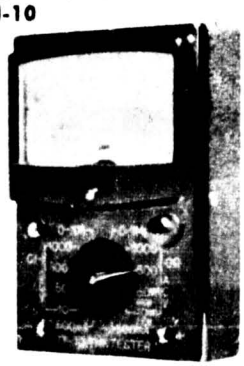
Model RH-10



RANGES:
DC Voltages: 0-10-50-500-1,000V.
DC Voltages: 0-10-50-500-1,000V. at 2,000 Ohms V.
AC Voltages: 0-10-50-500-1,000V at 2,000 Ohms V.
DC Current: 0-500uA 0-500 mA.
Resistance: 0-10K-1Meg; 60 ohms, 6K ohms at centre scale.
Capacitance: 25uuF to 1uF, in two ranges.
Decibels: 20 to plus 36db, two ranges.
Output: 0-100V in four ranges.
Size: 5in x 3¼in x 1¼in.
Weight: 13oz approx.
Price $10.75. Postage 50c to $1 extra.

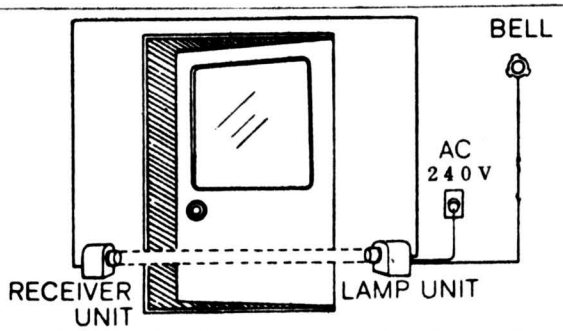
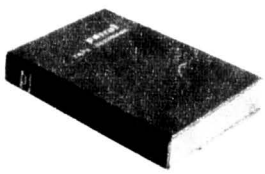


Photo-electric Alarm operates when beam of light across entrance, 18 feet maximum, is broken by intruder. No wires or moving parts. This magic eye can be connected to a bell or light to announce the entrance of visitors, etc. 240 V. mains required.

$39.00 or $40.00 posted.



BOOK TYPE

The latest model portable Tape-recorder. 4 transistor, 3in Reels, 2 track. Instruction manual. Size 10¼in x 7in x 1¼in.
Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price:

$19.95 posted anywhere.

"CONION" transistorised **SIREN ALARM** can be used for personal protection or as a burglar alarm. Loud siren sounds for 20 minutes when cord is disturbed. Pocket size, easily concealed.

$11.75 complete. Posted, $12.00.

MULTIMETER TESTERS

Model RH-50

Modern Design, 33 Micro-Amp Meter.
30,000 Ohms per Volt D.C.
13,000 Ohms per volt A.C.
1 p.c. Multipliers and Shunts used.
Printed circuit.
Clear Scale, rugged moulded case.

SPECIFICATIONS:
DC VOLTAGES: 0-0.25-1-2.5-10-25-100-250-500-1,000 V at 30,000 ohms per volt.
AC VOLTAGES: 0-2.5-10-25-100-250-500-1,000 V at 15,000 ohms per volt.
DC CURRENTS: 0.05-5-50-500 mA, 0-12 A.
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).
Decibels: Minus 20 to plus 56 dB (0 dB equals 1 mW, 600 Ohms).
Audio Out: Capacitor in series with AC Volt ranges.
Short Test: Internal buzzer.

Price $31

With leather case, **$38.00.** Postage 50c to $1 extra.

Accessory: 1 pr. heavy test leads.
Batteries: 1 (1.5V), 1 (15V).
Size: 3 5/16" x 6 5/16" x 2¾".
Weight: 1.4lb approx.

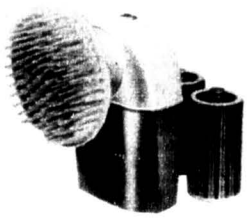
NEW MODEL A-10 MULTIMETER AND SIGNAL INJECTOR

With Test Leads and Injector Probe

30,000 O.P.V.

SPECIFICATION: 6in x 2½in scale.
DC Voltage: 0-0.5, 2.5, 10, 50, 250, 500, 1,000 V at 30,000 o.p.v. 5,000 and 25,000 V at 10,000 o.p.v.
AC Voltage: 0-2.5, 10, 50, 250, 500, 1,000 V at 10,000 o.p.v.
Volume Level in Decibels.
DC Current: 0-50 uA, 1, 50, 250 mA, 0-1 and 10 amps.
AC Current: 0-1, and 10 amps.
Resistance: 0-10K, 100K, 1M, 100 Megohms. Signal Injector Output Jack. Zenor Diode Overload Protection.

Price $54.00



"RIAM" Swiss-made battery-operated Vibratory Massager comes complete with two batteries, three applicators and instruction sheet.

$8.50 or $9.00 posted.

integration of satellites into existing telecommunication systems. They deal particularly with the following points:

Telecommunication satellite orbits: Orbits for telecommunication satellite generally fall within the limits of 500 and 40,000 kilometres above the earth surface. Of particular importance in recent years is the unique circular orbit in the plane of the earth's equator wherein the satellite is moving in the direction of the earth's rotation at an altitude of approximately 36,000 kilometres above the earth's surface. In this orbit, a satellite rotates synchronously with the earth and is thus stationary with respect to the earth's surface.

It is expected that a number of satellites in this orbit will be in close physical proximity and will be operating on the same frequencies. The minimum physical spacing between satellites in the stationary orbit will depend on the resolving power of the receiving equipment and the degree to which the power from the transmitters can be focused to a narrow beam. Location of satellites in the stationary orbit also presents problems concerning the transmission delay and access to the satellite communication system by a multiplicity of earth terminals. These characteristics must be considered in the integration of satellite communications into world telecommunication systems.

Propagation and noise: The effects of propagation and radio noise on space telecommunications are being studied, since they determine the most suitable frequencies for transmission in both directions between a space vehicle and the earth's surface. Frequencies for space telecommunications below 100MHz are severely influenced by the earth's ionosphere and frequencies above about 5,000-MHz are influenced by the constituents of earth's atmosphere.

Interference problem: In view of the occupancy of the radio frequency spectrum and the consequent frequency allocations which have been made by the competent radio conferences, a considerable amount of frequency-sharing must be accomplished between space communication services themselves, as well as between space communication services and terrestrial services. As the present frequency allocation stands, especially the latter problem is being considered by the C.C.I.R.

The concept of limiting the strength of the signal from the satellite at the earth's surface has been introduced, so that this signal should not cause interference to terrestrial systems and yet be of sufficient strength to provide a satisfactory signal for space services. A second interference problem is between the transmitter of a ground station of a satellite service and the receivers in a terrestrial service and, conversely, interference caused by transmitters of a terrestrial service to receivers of a satellite system. This problem has led to the introduction of the concept of co-ordination distance which is that distance within which mutual consultations between administrations will be required and beyond which the possibility of interference may be regarded as negligible.

ANTENNAE CONSIDERATIONS

In view of the large distances that will always separate a satellite from its ground station and the possibilities of interference between satellites, earth stations and terrestrial communications systems, large directional antennae have been required for the space service. The directional properties of these antennae including the effects of terrain are of considerable importance in determining the potential interference between various telecommunication systems and are under study in the C.C.I.R.

BROADCASTING FROM SATELLITES

The possibility of broadcasting from satellites to serve large unpopulated areas such as deserts and oceans and to bring broadcasting, both sound and vision, to areas where population is widely distributed and where existing terrestrial networks are limited both in extent and/or capacity is receiving considerable interest since the most recent Administrative Conference devoted to space communications in 1963.

There are essentially three types of services being envisaged using relay satellites, distribution satellites and direct broadcasting satellites. The C.C.I.R. is studying these possibilities and the technical and operational standpoint with particular emphasis on the transmitter power required for spacecraft, the most suitable frequencies and the possibilities of providing satisfactory receivers at a low cost.

OTHER SPACE TELECOMMUNICATION SYSTEMS

The choice of frequencies and various parameters in the case of radio navigation by satellites, meteorological satellites, near earth and deep space research satellites and manned spacecraft are also being studied by the C.C.I.R.

THE C.C.I.T.T.

C.C.I.T.T. is interested in the use of communication satellites for telegraph, facsimile, telephony and data transmission and for any signalling associated with these different types of communication. Several Study Groups have contributed to this work.

Since the communication satellites now in commercial operation are all high-altitude type, the problems raised by the Doppler effect and interruptions, when passage is effected from one satellite to another, are not urgent. With such satellites the factors which have the most serious effect on transmission quality are transmission delay and echo. For this reason, Study Group XII has proposed retaining for the time being the recommendation already issued on the subject in 1964. The limits given in the recommendation concerned are based on speech transmission quality. The data transmission with high transmission delay error control may raise difficulties and Special Study Group A is studying the matter.

C.C.I.T.T. Study Group IV considers the maintenance of satellite circuits, which sets some new problems, especially since the composition of such circuits has not been defined in the same way as for conventional systems.

The new telex and telephone signalling systems that have been recommended or are under study make allowance for the special features of satellite circuits.

Study Group II is considering the tariff problems raised by the use of satellite circuits for telephony.

JOINT STUDY GROUPS AND WORKING PARTIES

At its meeting in Mexico City in November 1967, the World Plan Committee, concluding the work of the Regional Committees, made an inventory of existing or projected communication satellites and the corresponding earth stations. It is possible to compare the total capacity of these satellites and other intercontinental routes, especially submarine cables, with telephone and telegraph traffic requirements for 1970 and 1975. The Plan Committee is also competent to receive requests for circuits for television transmissions, but no request for a permanent intercontinental circuit has been made yet.

Other Study Groups have begun to study television transmission standards for very long-distance circuits and the problems raised when sound is sent via terrestrial channels and the video signals via satellite.

A specialised working party has already assembled some costing data and will probably study the economic and technical comparison of satellite systems with other transmission systems in the period 1968-1972.

WIRELESS INSTITUTE ACTIVITIES

The 1968-1969 reprint of the Australian Radio Amateur Call Book will be on sale within the next few weeks. This publication will contain an up-to-date listing of all amateur call signs in the Commonwealth as well as other useful information to amateurs and short wave listeners. It is understood that the price will be 75 cents. As only a limited number will be printed, orders should be placed early, either with divisional secretaries or major book stalls.

NEW SOUTH WALES

The convention and field day season commences this month in the New South Wales Division. The first will be the Hunter Branch Field Day on September 22, followed by the South West Zone Convention on weekend commencing October 6. Details of both are given in these notes.

November 17 is the date set down for the Blue Mountains Field Day. Details next month.

Hunter Branch Field Day

The Annual Field Day of the Hunter Branch will be held on Sunday, September 22, 1968. The venue is Bolton Point Park on the western shore of Lake Macquarie.

Commencing with registration at 9.30 a.m. a full days program has been arranged. There will be:

144MHZ Hidden Transmitter Hunts.

144MHz Transmitter Hunts for pedestrians.

7MHz Hidden transmitter Hunts.

HF and VHF Scrambles.

Competitions to test skill and knowledge.

Lunch will be between 12.30 p.m. and 1.30 p.m. The day will conclude with the presentation of prizes at 4 p.m.

Registration fees: Adults, $1. Children under 16 years accompanying their parents —free. Y.R.S. members under 18 years —50c. Lunch will be provided.

A day out for the family at Bolton Point—September 22, 1968.

South West Zone Convention

The 1968 South-West Zone Convention of the N.S.W. Division will be held at Griffith over the holiday weekend, October 6-8.

All amateur operators are invited to bring their families and friends. Visitors from interstate will be particularly welcome.

Program

Saturday, October 5:

Venue—C.W.A. Hall, Banna Avenue, Griffith, N.S.W.

10 a.m. onwards: Registrations, Welcomes and Morning Tea.

2.30 p.m.: Visits to local points of interest.

6.30 p.m.: Convention Dinner—C.W.A. Hall.

8.30 p.m.: Social evening, slides and film of previous conventions.

144MHz Hidden Transmitter Hunt.

Sunday, October 6:

Venue—C.W.A. Hall.

10.30 a.m.: Morning tea.

11 a.m.: 144MHz Hidden Transmitter Hunt.

12.45 p.m.: Barbecue Lunch, Lake Wyangan.

2 p.m.: Blindfold transmitter hunts.

144MHz Hidden Transmitter Hunt.

4 p.m.: Prize Giving.

Afternoon Tea.

Monday, October 7:

10 a.m.: Meet at C.W.A. Hall, proceed to Gogeldrie Weir. Barbecue Picnic Lunch. Farewells.

Registration Fee: Men, $1. Ladies, 50c. Children free. Dinner, $2.00. Please book early, accommodation is limited.

All correspondence and inquiries should be adressed to:

Ted Druitt, VK2AXD,
13 Curtain Street,
Griffith, N.S.W. 2680.

QUEENSLAND

The Annual Convention of the Queensland Division held at Alexandra Headlands was a most successful event. Registrations for the weekend totalled 116 and the task of organising the activities was capably handled by the Bundaberg Amateur Radio Club members.

The prize list contained many excellent prizes donated by business houses.

Cairns A.R.C.

A new club, the Cairns Amateur Radio Club, has got off to a good start with 14 members. There are seven members currently studying for the A.O.C.P. examination in February and from reports their prospects are good.

An invitation is extended to persons interested in amateur radio to contact the Honorary Secretary, Cairns Amateur Radio Club, 36 Florence Street, Cairns, 4870, for full particulars of the club's activities.

Ipswich

There was a very large attendance of members and visitors at the sixth Annual Meeting of the Ipswich and District Radio Club. In his report, the outgoing president commented on the progress of the club. He stated that the membership had doubled since last year and now totalled 67. He also said that the club has a debt-free club house and that its financial position was very sound.

The election of officers for 1968-1969 resulted as follows:

President, G. Lloyd, VK4ZLG.
Vice-president, R. Grandison, VK4RG.
Secretary, J. Edwards, VK4ZJE
Treasurer, Mrs J. Lloyd, SWL-WIA4249.
Class Manager, R. Zimitat, VK4JZ.
Station Manager, W. Bryce, VK4ZN.
Public Relations Officer, W. Jehn, SWL-WIA4001.

SOUTH AUSTRALIA

The council of the South Australian Division is negotiating the lease of a piece of ground on Shepherds Hill Road, in the foothills of the Mount Lofty Range, as a permanent site for the division's station VK5WI. A long term lease and the construction of a building and antenna masts will enable the division's transmitting and receiving facilities, for operation on all bands from 80 to 2 metres, to be operated from the one location.

JAMBOREE-ON-THE-AIR

The 11th Jamboree-on-the-Air will be held during the weekend October 19-20. This event has gained world-wide popularity among amateur radio operators and Boy Scouts alike. It has proved to be an excellent opportunity for members of the various Boy Scout associations throughout the world to renew old friendships and the amateur operator to introduce young people to amateur radio. The close co-operation that now exists between members of the two organisations has resulted in quite a number of scout groups operating their own stations.

For those operators who may be concerned about a clash of dates as there was last year with the "CQ" DX Contest, this problem has been overcome by an agreement with the "CQ" magazine to hold the J.O.T.A. on the third full weekend in October each year. The "CQ" DX contest will be held on the following weekend.

A review of the report on the 1967 J.O.T.A. compiled by the Boy Scout World Bureau, received from Noel Lynch, National Organiser for Australia, and other notes of interest on the event will be included in next month's notes.

PREVIEW OF SSB TRANSCEIVER

The interest of Australian amateurs will no doubt be aroused by the news of the proposed production by Australian Consolidated Industries, of an amateur band single-sideband transceiver.

At a demonstration on July 17, 1968, in the company laboratories 813 Dowling Street, Waterloo, Sydney, Dr A. Draycott, Manager of A.C.I. Technical Centre, John de Teliga, Laboratory Manager, and John Bays, Senior Development Engineer, Process Control and Electronics Group, announced plans for production by A.C.I. of a range of single-sideband transceivers.

While the project, in the main, is to produce fixed frequency SSB transceivers for commercial and public utility services, the company has decided to incorporate within the range a multiband transceiver for the amateur service.

Present at the demonstration and discussion on the project were representatives from the military services, civil defence, commercial organisations who are required to change to the SSB mode within the next few years, the Radio Branch of the Postmaster-General's Department and several members of the amateur service.

The prototype amateur unit demonstrated was a five-band all-valve transceiver, using crystal filters. In spite of high noise level from local and nearby industrial equipment, it gave a very good performance. The transceiver, to be sold under the trade name "ACITRON," is based on a proven unit developed in England. Several special features have been incorporated and all stages of production thoroughly checked in the company's very extensive laboratory facilities.

The unit has an attractive appearance with a centrally located dial with straight line tuning and vernier calibration scale. A crystal calibrator and permanent VOX control are incorporated. The power amplifier uses a pair of 6146Bs, while the AC power supply and loud speaker unit are contained in a separate matching case. A 12V DC mobile power supply unit will also be produced. A remote VFO with AC power supply and loudspeaker is also included in the range. Provision has been made for CW operation.

Although the date of release on the market was not announced, the following prices have been given:

Acitron 200: Five band transceiver, $470.

Acitron 1001: AC power supply and loudspeaker unit, $100.

Acitron 101: 12V DC Mobile power supply unit, $150.

Acitron 1002: AC PSU and remote V.F.O. unit, $200.

W.I.A. YOUTH RADIO SCHEME

In recognition of his work for the Youth Radio Scheme, Rex Black, VK2YA, has been appointed a Life Member of the Youth Radio Club Scheme. The appointment was made at the conference of state supervisors held in Melbourne last June. Although retired from office as Federal Co-ordinator and N.S.W. State Supervisor, Rex continues to take an active part in the overall planning of the scheme's activities.

NEW SOUTH WALES

The N.S.W. Division Y.R.S. management committee hold their monthly meeting at Wireless Institute Centre, 14 Atchison Street, Crows Nest, on the third Friday of each month, at 7.30 p.m. This coincides with the short-wave listeners' meeting, which Y.R.S. members are welcome to attend. Short-wave listening is a natural introduction to amateur radio and Y.R.S. members can benefit from the experience of S.W.L. members.

The facilities of the New South Wales division's communication centre at the Wireless Institute Centre will be used for Y.R.S. broadcasts from 7 p.m. to 7.30 p.m. on Y.R.S committee meeting nights The station will operate in the 80-metre band, under the call sign VK2AWI.

Maitland Radio Club

The Maitland Radio Club is now producing a monthly magazine in place of the single sheet newsletter. Known as the "M.R.C. News," it is edited by Bill Plant, VK2AMM, assisted by an enthusiastic publishing committee. The first issue of the magazine was released at the beginning of August. The cover design was the result of a competition among members, the winning entry being submitted by Garry Watson, of East Maitland.

Several interesting and informative lectures have been presented to members. A most important subject was covered by Mr O. Watts, of the Maitland Ambulance Service, on first aid, rescue and resuscitation in cases of electric shock. Safety in the workshop and the correct use and care of tools was the subject of a short lecture by Bill Plant, VK2AMM, while the principle and construction of transformers was covered by Bob Roper. Bob is an engineering officer with the Hunter Valley County Council and has offered to give further lectures to the club.

Members have also gained a greater appreciation of the mathematics involved in the design of radio equipment from the lectures by Mr R. V. A. Johnson, principal of the Maitland Technical College.

The club's new workshop in Maize Street, East Maitland, has been completed and equipped with work-benches, shadow-boards and storeroom. Transmitting and receiving equipment has been installed and the club stations VK2BHV and VK2ZVM will soon be on the air.

Club president Kev Watson, VK2ZKW, has been guest of honour at the Apex and Rotary Clubs in the Maitland district, where he spoke on the aims and achievements of the Wireless Institute of Australia, the Youth Radio Scheme, amateur radio in general and the Maitland Radio Club in particular.

SOUTH AUSTRALIA

An Elementary Certificate examination was held at Elizabeth on July 20. Four members of the Elizabeth Amateur Radio Club were candidates and all obtained good passes. The results were:

Christopher Elmes	79 per cent
Eldred Francis	79 per cent
Dean Strugnell	71 per cent
Johannes Wilkes	79 per cent

Bert Hollebon, publicity officer for the Y.R.S. in South Australia, would like to hear from clubs regarding their activities. Bert's address is 26 Nelson Street, Port Pirie, S.A. 5540.

QUEENSLAND

Two new clubs have registered with the Queensland Division Y.R.S.: the Mackay Christian Brothers; and the 21st Company of the Boys Brigade, Brisbane. Leader of the Boys Brigade Club, R. Goleby, would like to contact any amateur who could assist the club in joining the Y.R.S. Hook-up. The club has 12 members.

The Y.R.S. hook-up is held on the first Saturday of each month at 9 a.m., on the 40 metre band. Call signs to look for are VK4UC, VK4BW, VK4NN, VK4LZ, VK4JI and possibly VK9FS.

The Yeronga High School Radio Club continues to make excellent progress. During July more than 30 members sat for Y.R.S. Certificate examinations.

The Gympie Radio Club Youth Section recently had an increase of six members due to local press reports on the club's activities.

Students from the Ipswich Grammar School and St. Columban's College sat for Y.R.S. Certificate examinations at the end of July.

Rex Black, VK2YA, who has been elected a life member of the Y.R.C. Scheme.

WESTERN AUSTRALIA

A report on the activities of the VK6 Division of the W.I.A. indicates a growing concern among members to interest students in amateur radio. John Morgan, VK6RT, Y.R.S. supervisor, invites any licensed amateur to join his enthusiastic group and assist in organising clubs for the various youth organisations in their areas.

Although the number of Y.R.S. clubs is small compared with the eastern States, the scheme continues to flourish in Western Australia. Six clubs are registered with the division: Wesley College, Christian Brothers College, Leederville; Aquinas College; Bunbury High School, Christ Church Grammar School.

A total of 22 Elementary Certificates have now been issued to successful students. It has been noted that many former members have obtained positions in industry through their knowledge acquired through Y.R.S. Club activity.

Recently, a large group of boys from the Aquinas College Radio Club sat for their first Y.R.S. examination. No fewer than 26 Elementary Certificates were awarded, and 16 of the boys gained honours.

Scouts, Boys' Brigade or Police Boys' Clubs may obtain full particulars of the Youth Radio Scheme by writing to Rev. Bro. J. Morgan, Y.R.S. Supervisor, Box N1002, G.P.O., Perth, 6001, W.A.

Here are the delegates who attended the recent Youth Radio Scheme Convention in Melbourne. Back row (left to right): Jim Webster, Bob Gutherlet, Michael Plummer. Centre row (left to right): David Jeanes, Jack Flynn, Bill Tremewen. Front row (left to right): Reg Emmett, Don Reid, Harry Smith, Ken Pincott.

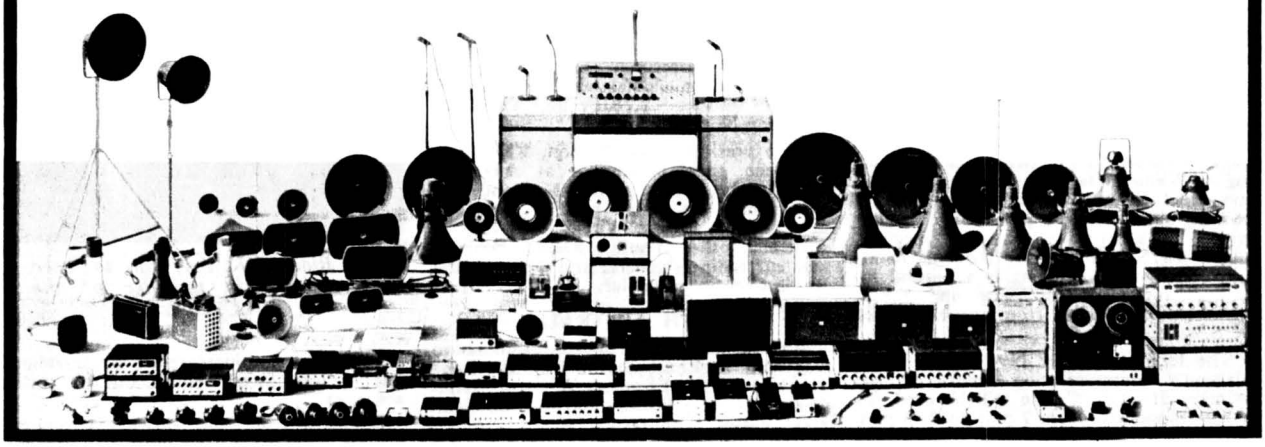
TOWNSVILLE AMATEUR RADIO CLUB

Office-bearers for the current year, elected at the Annual General Meeting of the Townsville Amateur Radio Club, are:

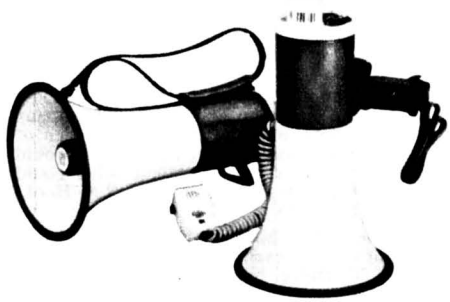
President: W. Sebbens, VK4XZ.
Vice-presidents: P. Lindsay, VK4ZPL, R. Ramm, VK4RO.
Secretary: G. Richardson, VK4ZGJ.
Treasurer: R. Grummit, VK4ZRG.
QSL Officer: R. Sayers, VK4ZRS.
Publicity: R. Wilson, VK4RW.
Class Instructor: L. Noseda, VK4EX.

The past year saw a slight increase in membership of the club, and considerable improvement financially was recorded in the annual report. The construction of a 20ft by 10ft building on council land donated to the club, situated on the slopes of Castle Hill overlooking the town, is the major project under consideration.

Now hear this!



World renowned TOA P.A. equipment from AWA



If you've got something important to say, if you direct traffic, train a football team, organise a fire-fighting brigade, direct a construction team, air your views, start a yacht race, make a movie, you need a TOA electronic voice amplifier.

Project your voice up to a mile

TOA voice amplifiers are easy to carry, rugged, easy to operate, fully transistorised and absolutely foolproof.

And there is a model for every application.

TOA equipment delivers high-efficiency, long life and the kind of full colour sound that stretches carrying power and reliability in the most difficult conditions. TOA is one of the world's top P.A. equipment manufacturers.

TOA comes to Australia backed by the unrivalled AWA sales and service organisation. See your AWA retailer.

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED
Australia's National Wireless Organisation

TOA ELECTRIC CO. LTD.
Public Address Equipment.

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED: Sydney, Newcastle, Canberra, Brisbane, Melbourne, Hobart, Launceston, Adelaide, Perth; and also Chandlers Pty. Ltd., Queensland, and Newton McLaren Ltd., South Australia.

732

AUSTRALIA — NEW ZEALAND — OCEANIA DX CONTEST

The national amateur radio associations in New Zealand and Australia —New Zealnd Association of Radio Transmitters and Wireless Institute of Australia — invite world-wide participation in the 1968 VK/ZL/ Oceania DX contest. This annual contest is very popular with overseas amateur operators and short-wave listeners and the organisers invite all licensed amateur operators in Australasia to participate.

OBJECTS:
For the "world" to contact VK-ZL-Oceania stations and vice versa. Note: VK and ZL stations, irrespective of their location, do not contact each other for contest purposes.

DATES:
Phone: 24 hours from 1000 hours GMT Saturday, October 5, 1968, to 1000 hours GMT Sunday, October 6, 1968.
C.W.: 24 hours from 1000 hours GMT Saturday, October 12, 1968, to 1000 hours GMT Sunday, October 13, 1968.

RULES:

1. There shall be three main sections to the contest—
   a. Transmitting — phone.
   b. Transmitting — C.W.
   c. Receiving — phone and CW combined.
2. The contest is open to all licensed amateur transmitting stations in any part of the world. No prior entry need be made. Mobile marine or other non-land stations are not permitted to enter.
3. All amateur frequency bands may be used, but no cross-band operation is permitted.
4. Phone will be used during the first week-end and CW during the second weekend. Stations entering both sections must submit separate logs.
5. Only one contact on phone and one contact on CW per band is permitted with any one station for scoring purposes.
6. Only one licensed amateur is permitted to operate any one station under the owner's call sign. Should two or more operate any particular station, each will be considered a competitor and must submit a separate log under his own call sign. (Note: This is not applicable to overseas competitors.)
7. Entrants must operate within the terms of their licenses.
8. Cyphers: Before points can be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of the RS (telephony) or RST (CW) report plus three figures which may begin with any number and which will increase in value by one for each successive contact. E.g., if the number chosen for the first contact is 021, then the second must be 022 followed by 023, 024, etc. After reaching 999, start again from 001.
9. SCORING:
   (a) For Oceania stations other than VK/ZL. Two points for each contact on a specific band with VK/ZL stations; one point for each contact on a specific band with the rest of the world.
   (b) For the rest of the world other than VK/ZL. Two points on a specific band with VK/ZL stations: One point for each contact on a specific band with Oceania stations other than VK/ZL.
   (c) For VK/ZL stations:
   Five points for each contact on a specific band and, in addition, for each new country worked on that band, bonus points on the following scale will be added—

1st contact	50 points
2nd contact	40 points
3rd conact	30 points
4th contact	20 points
5th contact	10 points

   For this purpose the A.R.R.L. countries list will be used with the exception that each call area of W/K, JA SM, UA will count as "countries" for scoring purposes as indicated above.
10. LOGS:
   (A) Overseas stations:
   a. Logs to show in this order—date, time in GMT, call sign of station contacted, band, serial number sent, serial number received, points. Underline each new VK/ZL call area contacted. Separate log for each band.
   b. Summary sheets to show call sign; name and address in block letters; details of station; and, for each band, QSO points for that band, VK/ZL call areas worked on that band.
   All-band score will be total of QSO points multiplied by sum of VK/ZL call areas on all bands, while single band scores will be that band QSO points multiplied by VK/ZL call areas worked on that band.
   (B) VK/ZL stations:
   a. Logs must show in this order—date, time in GMT, call sign of station worked, band, serial number sent, serial number received, contact points, bonus points. Use a separate log for each band.
   b. Summary to show—name and address in block letters, call sign, score for each band by adding contact and bonus points for that band, and "all band" score by adding the band scores together; details of station and power; declaration that all rules and regulations have been observed.
11. The right is reserved to disqualify any entrant, who, during the contest has not strictly observed regulations or who has consistently departed from the accepted code of operating ethics.
12. The ruling of the NZART Executive committee will be final.
13. AWARDS:
   VK/ZL stations: The NZART will award certificates to the top scorer on each band and the top scorer in each VK/ZL district and silver mounted plaques to the top ZL scorers in both phone and CW sections.
   Overseas stations: Certificates will be awarded to each country (call area in W/K JA, SM and US) on the following basis:—
   1. Top scorer using "all bands."
   2. Top scorer on individual bands.
   3. Other certificates may be awarded to be determined by conditions and activity.
14. ENTRIES:
   Entries from VK/ZL stations should be posted direct to:—
   N.Z.A.R.T. Contest Manager,
   152 Lytton Road, Gisborne, New Zealand,
   to arrive not later than December 31, 1968.
   Entries from overseas stations should be posted to above address or:—
   N.Z.A.R.T.
   Box 489, Wellington, New Zealand.
   to arrive not later than January 21, 1959.

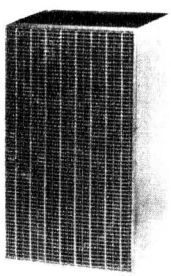
S.W.L. SECTION

1. The rules are the same as for the transmitting section, but it is open to all members of any S.W.L. society in the world. No transmitting station is permitted to enter this section.
2. The contest times and logging of stations on each band per weekend are as for the transmitting section except that the same station may be logged twice on any one band, i.e. once on phone and once on CW.
3. To count for points logs will take the same form as for transmitting—as follows: date, time in GMT, call sign of station heard, call sign of the station he was working, RS(T) of the station heard, serial number sent by the station heard, band, points claimed. Scoring is on the same basis as for transmitting section and the summary should be similarly set out.
4. Overseas stations may log only VK/ZL stations, but VK receiving stations may log overseas stations and ZL stations while ZL receiving stations may log overseas stations and VK stations.
5. Certificates will be awarded to the top scorer in each overseas scoring area and in each VK/ZL call area.

"MYERS" AUTOMOBILE STEREO TAPE PLAYER

Power Supply: 12V DC (Rated Power requirement less than 1.0 ampere.) Cartridge Tape: Size 3 Cartridges of both 4 and 8 track. Playback Head: 4 and 8 track compatible, automatic starting and automatic channel selecting. Transistors: 12-transistor (Silicon-used and OTL system). Tape Speed: 3-/¾" per second, plus 3% minus -1%. Drive Motor: DC Micro motor with Governor.
Frequency Response: 70—10,000 cps. Wow and Flutter: Less than 0.3% WRMS (when using standard tape). Separation (Cross Talk): Better than 45db. Signal to Noise Ratio: Better than 40db. Price $99.50.
Also available for 240V A.C. Operation only. Includes Pick-up or Radio Inputs. $99.50.

MULLARD MAGNAVOX



BOOKSHELF ENCLOSURE
Maple, Teak or Walnut
Complete $24.75
SUPER BOOKSHELF $36.75.
Post: N.S.W. 50c. Interstate $1.00.
CABINETS ONLY
R. H. BOOKSHELVES $11.50
MULLARD $10.95

PLAYMASTER BOOKSHELF UNITS
6in 8in 10in 12in
$27.75 $33.50 $35.50 $36.50

PLAYMASTER 4
With Phillips Special Speaker.
$35.75

GUITAR AMPLIFIERS

10-Watt, Two-Channel, with Twin Cone Speaker $53.45
14-Watt, 4 Inputs, Bass and Treble Boost. 2 Twin-Cone Speakers, $63
17-Watt, Four-Channel, Bass and Treble Boost. Two Twin-cone Speakers $76.25

35 WATT

4-Channel, Bass and Treble Boost. 4 Twin-Cone Speakers .. $109.05
Vibrato with foot control and 2 preset controls for frequency and intensity. $10.50 extra on above models.

35 Watt with
REVERBERATION & TREMOLO
4 input channels. Bass treble and boost. Tremolo, Speed and depth controls, Reverb, intensity. 2-foot controls. 4ft 8in Speakers.
$163.50

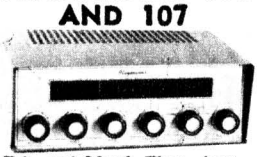
Slap Bass or Bass Guitar
AMPLIFIERS
35 WATT.
4 Inputs. Bass and Treble boost. Special 15in Woofer Speaker reproduces to 20 cycles.
$159.75

PIGGY BACK GUITAR AMPLIFIER
30 Watt $79.75
45 Watt $99.75
60 Watt $119.75
4 Inputs. Bass and Treble Boost. Vibrato if required, $10.50 extra.

ELECTRIC GUITAR

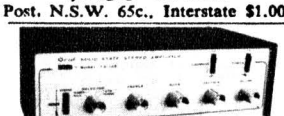
Pickup Units $8.75
Accordion Pickup Units .. $8.75
Harmonica Pickup Units .. $1.95
Post, N.S.W. 40c; Interstate, 75c.

PLAYMASTER 106 AND 107

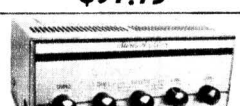


Feb. and March Elect. Aust.
106
WIRED AND TESTED **$88.75**
107
WIRED AND TESTED **$79.00**

CHANGER PLATFORMS
Teak Finish.
PERSPEX DOMES
Fits All Current Models.
MINIBOX SPEAKER CABINETS
Teak or Walnut Finish.
Takes Magnavox 6in Speaker and 3in Tweeter.
All One Price
$7.50 EACH
Post. N.S.W. 65c., Interstate $1.00.



240v A.C. POWERED SOLID STATE STEREO
T.S.135
18 Transistor, 15-watt per channel.
Inputs for Tape. Mag. P.U. Ger. P.U. Radio Aux.
Frequ. Range 30c to 20KC.
Max Sensitivity 3 MV.
Speaker matching 4 to 15 ohms.
$78.00



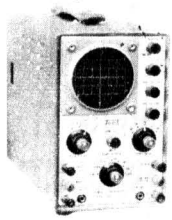
A.2C. STEREO AMPLIFIER
5 WATTS PER CHANNEL.
Valve Unit. 240v A.C.
Input for Crystal and Ceramic P.U. Radio and Auxiliary.
Output for 4, 8, 15 ohms.
Cross talk better than -40db.
Sensitivity 50 MV.
$47.50

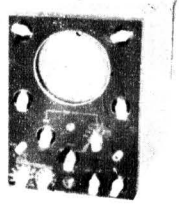
FUZZ BOX
FUZZ BOX E. AND A. AUG. WIRED AND TESTED. $15.
Post., 75c.

REVERB UNIT
COMPLETE with AMPLIFIER. E.A. October issue. Kitset $39.95. Wired and tested, $41.95.

SIGNAL GENERATOR
Deluxe Model TE-20D.
Freq. range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal. Suitable for self calibration Marker generator. Printed circuit. 240 T.E.20 $25.50. V.A.C. $27.50
Post., N.S.W., 75c; I'state $1.25.
LEADER L. SG. 11. $31.75.

TEST EQUIPMENT

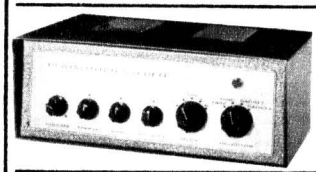




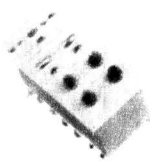
WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth Push-pull vertical and horizontal Amplifiers, 8 positions, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch $99.75; 5-inch $111.50



PLAYMASTER 115
The new solid state Stereo-Amplifier. April issue.
Wired and tested $104.00
Kit Set $90.00
Pre-amp to suit magnetic cartridge 12.00



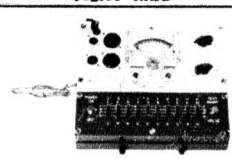
119 STEREO TAPE ADAPTER
Suits all Playmaster Stereo amplifiers and others that accept crystal P.U.
Kitset $79.00
Wired and tested $96.00

TAPE PLAYBACK KITSET
BSR deck with parts for transistor pre-amp and circuit.
$30.00
Post $1.25 N.S.W., $2.00 Interstate.

Easy to build. Mi-Fi quality.
TAPE DECKS B.S.R.
2 Track, 3¾ i.p.s.
$25.50
4 Track, 3 Speed Stereo.
$41.50

4-CHANNEL MICROPHONE MIXERS
Transistorised Battery Powered.
$97.75

PLAYMASTER 118
KITSETS $79.75.
Wired and tested, $89.75.
Fitted with Pre-Amp to suit Magnetic Cartridge.
$12.00 extra



VALVE TESTER
Tests all valves, diodes, rectifiers, checking filaments, shorts, Merit on direct reading. Good-bad meter. Complete with tube chart.
$26.75
Post., N.S.W., 25c; I'state, $1.25.

T.E. 50-99-5011
Checks, Nu Vistas, Compactrons, etc.
$34.25

G.D.O. UNITS
Leader 810. 6-Band, 2 Mcs to 260 Meg Nuvistorised, 240 V.A.C. Operation. Modulated, Calibration. Accuracy 2 per cent.
$41.50

T.E. 18 Lafayette. 8 Bands, 360 K.C. to 260 Megs. 240 V.A.C. operation.
$39.50
Post., N.S.W., 50c; I'state, 75c.

T.E. 15 Transistorised, 7 Band, 360 Kc to 270 Megs.
$34.75

AUDIO GENERATOR
De Luxe Model TE—22D.
Freq. range. Sine 20 cps—200 KC. SQ. 20 cps—25KC. Output voltage, Sine 7V. SQ. TV P.-P. Output impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation. 1/1, 1/10, 1/100, 1/1K. Printed circuit. 240V A.C.
$41.50

SIGNAL INJECTOR
Transistorised. Fountain pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service.
$5.75. Post. 25c.

TRANSISTOR AND DIODE TESTER
E.A. August, '68.
Wired and Tested.
$57.00
KIT SET $48.00

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Best Latin American Signals for Years

Reception of signals from South and Central America during the past few weeks has been the best for many years. The following survey of some of the most interesting stations heard in this period is therefore particularly appropriate.

Our thanks go to Bob Padula, Melbourne; Dean Lynneburg, Wellington, N.Z.; George Beardsmore, Dunedin, N.Z.; and to a number of other contributors, for their help in compiling this list. The signals are heard in both the late afternoon and late evening listening periods, and while by no means comprehensive, the list contains information on some of the most interesting signals heard this season.

KHz Station

2410 Radio Sirena Leopoldina, Brazil, heard at 0900GMT.
3275 ZYR31, Radio Club Buaru, Brazil, heard at fair level at 0830GMT.
3325 YVRA, Radio Monagas, Venezuela, noted at around 1015GMT.
3390 HCOT1, Radio Zaracay, Ecuador, broadcasts all night.
3995 HCJA5, La Voz del Rio Tarqui, Ecuador, close down 0630.
4735 HCEH3, Radio Progresso, Loja, Ecuador, heard all night.
4755 CP62, Radio Emissora, Bolivia, closes at 0600 and opens at 1000.
4785 OAX3V, Radio Horizonte, Peru, closes at 0500.
4785 HOFA4, La Voz del Manabi, Ecuador, heard until after 0700 on Sunday.
4795 Radio Reloj, Bogota, Columbia (new station), heard as late as 0700.
4805 Radio Popular de Cuenca, Ecuador heard broadcasting all night.
4820 HRVC, Tegucigalpa, Honduras (Gospel Station), heard closing 0400 and opening 1000.
4830 HCJS1, Ondas del Angel, Ecuador, opens at 1055.
4860 OCX4B, Radio Callao, Peru, sign off 0510 on Sunday.
4905 ZYZ20, Radio Relogio, Federal, Brazil, heard with continuous spoken program at 0500.
4923 HCRQ1, Radio Quito, Ecuador, opens at 1100.
4970 YVLK, Radio Rumbos, Venezuela, sign on at 0955.
4980 YVOC, Ecos del Tordes, Venezuela, sign on at 1000.
5025 CP75, La Cruz del Sur, Bolivia, opens at 1000 with Gospel program.
5965 ZYU60, Radio Guiaba, Brazil, heard at 0900.
6005 CP58, Radio Progresso, Bolivia, closes at 0430 and opens 0900.
6010 OAX4V, Radio America, Peru, heard around 0800.
6060 HRU, Radio Centro, Honduras, fair at 1200.
6090 RAE Buenos Aires, Argentine, opens in English 0300.
6095 ZYB7, Radio Sao Paulo, Brazil, heard at around 0915.
6905 HJIW, Radio Del Centro, Columbia, opens at 1000.
6100 CE610, Radio Calama, Chile, heard on Sundays at 0600.
6115 OBZ40, Radio Union, Peru, closes at 0500 and also heard 1045.
6115 HJIQ, Radio La Voz del Llano, Colombia, opens at 1010.
6120 LRX1, Radio El Mundo, Argentina, sign off 0600 Sundays.
6140 HJNE, Radio El Sol, Colombia sign on 1000.
6160 HJKJ, Radio Emisora, Nueva Granada, Colombia, heard well at 0700.
6165 XEWW, Mexico, opens at 1145.
6170 YVKG, Radio Nacional, Venezuela, sign on 1000.
6175 ZYV74, Radio Guarani Brazil, heard well at 0800.
6180, TGWB, Guatemala, heard at around 0445.
6195 HJEZ, La Voz de Cali, Colombia, heard around 1000.
9562 OAX4R, Radio Nacional, Peru, sign off 0500 and opens at 1130.
9615 TIRICA, Voz de la Victor, Costa Rica sign off 0500.
9625 OAX8K, Radio Atlantida, Peru, noted at around 0430.
9653 OAX9G, Radio Nor Peruana, Peru, heard at 0330.
9690 CE970, La Voz de Chile, heard at 0330.
9710 LRX2, Radio El Mundo, Argentina, heard at 0130.
9752 CE975, Radio Mineria, Chile, closes at 0400.

FURTHER EXPANSION AT TIRANA

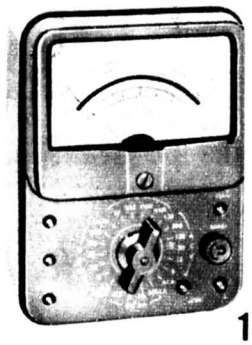
In a recent issue we commented on the expansion of Radio Tirana (Albania) into foreign broadcasting and this has again increased in recent weeks. English is now broadcast in 17 half-hour programs each day, Russian 15, German 8, and Polish and Spanish has also been expanded to give a total of 65 broadcasting hours each day in the overseas services.

English services are on the air as follows:

GMT	Area Served	KHz.
0030-0100	North America	6195, 9507
0130-0200	America	6195, 9507
0230-0300	America	6195, 7285, 9507
0330-0400	America	7300, 9495
0430-0500	Africa	7300, 9495
0630-0700	Africa	7135, 9507
0700-0730	Asia	7300, 9507
0930-1000	Asia	9507, 11840
1100-1130	America	9507, 11840
1400-1430	Asia	9507, 11840
1530-1600	Africa	9495, 11840
1630-1700	Africa	9495
1730-1800	Africa	9507
1830-1900	Africa	7135, 9495
1930-2000	Africa	9507
2030-2100	Africa	9495
2200-2230	Africa	7135, 9507

SANWA

HIGH SENSITIVITY MULTI TESTERS



MODEL
430 ES
$52·30
INCL. S.T.

100,000 OHMS/VOLT

This unit has a 10 microampere movement giving sensitivity of 100k ohms/volt for all DC ranges to 300 volts. The movement is supported by spring backed jewels and is protected by a parallel diode. Frequency response is to 100 KHZ

MEASUREMENT RANGES:

DC Voltage: 0.3v-3v-12v-30v-120v-300v (100kΩ/v)
1.2kv-6kv-30kv (with probe) (16.6kΩ/v)

DC Current: 12ma-0.3ma-3ma-30ma-300ma-1.2a-12a-300mv

AC Voltage: 3v-12v-30v-120v-300v-1.2kv (5kΩ/v)

AC Current: 1.2a-12a

Resistance: Up to 50 megohms (40 ohms to 400k ohms midscale)—decibel scale is provided

MODEL
EM700
$117
INCL. S.T.

12 MEGOHMS

A high sensitivity circuit tester using field effect transistors to provide 12 megohm input impedance on DC and 1 megohm on AC ranges. It has wide frequency response and internal self-calibration facilities are provided.

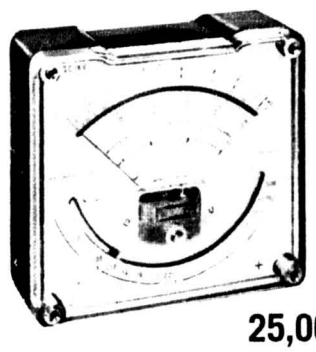
MEASUREMENT RANGES:

DC Voltage: ± 0-0.3v-1.2v-3v-12v-30v-120v-300v-1200v
± 0-30kv with HV probe used jointly
Internal resistance — 10mΩ for 0.3v/12mgΩ for other ranges

DC Current: ±0-0.03μa-0.1μa-10μa
± 0-1.2ma-12ma-120ma-300ma
} Terminal voltage—300mv

AC Voltage: 0-1.2v-3v-12v-30v-120v (on X1 range)
0-300v-1200v (on X10 range)

Resistance: 0 to 1000 megohms (75 ohms to 7.5 megohms midscale)—decibel scale is also provided.



MODEL
F80 TRD
$32·60
INCL. S.T.

25,000 OHMS/VOLT

A unit with a 34.5 microampere movement and 25k ohms/volt sensitivity. It has a taut band suspension which will withstand impact and vibration. Ranges are smoothly changed over by a unique design rotary-ring switch. The meter movement is automatically protected from accidental impression of high current. The L1 and LV scales provided check all types of semi-conductors. The germanium diode rectifier extends frequency response of the low AC voltage ranges up to 100k cycles. Even the AC volt range checks voltages of 20k cycles.

MEASUREMENT RANGES:

DC Voltage: 0.25v-2.5v-10v-50v-250v-500v-1000v (25kΩ/v)

AC Voltage: 2.5v-10v-50v-250v-500v-1000v (5kΩ/v)

DC Current: 40μa-0.5ma-5ma-50ma-500ma

Resistance: From 100 ohms to 250k ohms midscale in 4 ranges

Load Current: L1-15ma-1.5ma-150μa

Load Voltage: LV-1.5v

Volume Level: −10~+10db-+5~+36db

AVAILABLE EX STOCK FROM

WF WARBURTON FRANKI

ADELAIDE: 23-3233; BRISBANE: 51-5121; HOBART: 2-1841; LAUNCESTON: 2-1218; MELBOURNE: 69-0151; MOUNT GAMBIER: 2-3841; NEWCASTLE WEST: 61-4077, PERTH: 8-4131; SYDNEY: 29-1111; WOLLONGONG: 2-5444.

WF130/68

NEW SCHEDULES OPERATING

NEW STATIONS AND HIGHER POWER

A review of new stations and increased powers is listed below from a recent survey in the "Sweden Calling DXers" bulletin.

ABU DHABI: The Abu Dhabi Broadcasting Service has under construction at its site on the Persian Gulf a high powered medium and short-wave transmitting site, which will be in operation shortly.

HONG KONG: Radio Hong Kong is building a new Broadcasting House, which will be sited at Kowloon. This will have 16 studios and recording rooms, with engineering control rooms, workshops and other ancillary departments.

MALAGASY: Radio Nederlands is to build a new relay base in Madagascar, on a site already purchased. This new base will give better reception in Australia, New Zealand, Far East, Central Africa and East Africa.

NEW CALEDONIA: According to ORTF Paris, a Broadcasting Centre at Noumea will be replaced by a new Centre at Sainte Marie, opposite Noumea. The new centre will be in operation late next year, and will house three transmitters of 20KW each using 1420, 3355 and 7170KHz. Other frequencies to be used will be 4913, 9510KHz.

SAUDI ARABIA: The Saudi Arabia Broadcasting Service plans a huge broadcasting station, which will be built by French and West German contractors.

COSTA RICA: Deutsche Welle, Cologne, Germany is negotiating with the Costa Rican Government for rights to build a 1500KW medium wave station for relay purposes. It is expected that the United States and Canada may object to the use of any frequency which would interfere with their broadcasts.

NETHERLAND ANTILLES: Radio Nederlands, Hilversum, Holland, has under construction two 300KW transmitters at a site on Bonaire. These transmitters will be powered by four diesel generators of 200KW each, and the station will also have an antenna array of 21 different aerials.

UNITED STATES: The Voice of America has announced that it has recently put into operation five new transmitters, three at Bethenay, Ohio, and one each at Delano and Dixon, in California. The transmitters are each of 250KW. Two additional units are to be added at both Delano and Dixon. Operating schedule of the new transmitters from the California relay is as follows:

Site	KHz	GMT
Delano	17850	2130-0230
	15410	0400-0080 (A.F.R.S.)
	11830	0900-1030,1100-1730
Dixon	17895	2130-0130,0230-0245, 0300-0330
	11865	0800-1700

HJCN ON 4795KHz

A new Colombian station with the slogan "Radio Reloj" at Bogota has been heard with typical Spanish programs to close down as late as 0700GMT on 4795KHz. This new station has confirmed our reception with a card which gives the power as 1,000 watts. It relays HJCN on 1100KHz, which uses 10KW. The station belongs to the CARACOL network and the address for reports is: Apartados, Aereo 92-91, Bogota, Colombia. The verification was issued by the technical department of Radio Reloj.

INDONESIAN AIR FORCE RADIO

A verification has been received from the Indonesian Angkatan Udara Republik Air Force radio station, which confirms our reception of the broadcasts on 11910KHz at 1000GMT.

The station now has two transmitters which are on the air 0500-0800 and 1000-1400GMT. The other frequency of 2475KHz uses 500 watts, and transmits on

BROADCASTS FROM CAIRO

The complete schedule of broadcasts from the Egyptian Broadcasting System is now as follows:

GMT	Language	KHz
1615-1715	Turkish	6230
2030-2330	Arabic	7050
0300-0500	Arabic	7075
1900-2255	Arabic	7075
0200-0500	Arabic	7095
0300-0500	Arabic	9450
0000-0430	Arabic, French, Spanish English (0200-0330)	9475
0500-1030	Arabic	9475
1200-2300	Arabic, Amharic, Italian, French, German, English (2145-2300)	9475
1500-2255	Arabic	9495
1730-1830	Russian	9755
2200-2245	Arabic	9780
0300-0800	Arabic	9795
1100-2000	Arabic	9795
1500-1855	Arabic	9820
1023-2025	Arabic	11655
2030-2330	Arabic	11655
0500-0805	Arabic	11685
0200-0500	Arabic	11765
0300-0500	Arabic	11915
1200-1815	Arabic, Amharic, Somali	11915
0500-0800	Arabic	11980
1000-1100	Arabic	11980
1900-2255	Arabic	11980
1830-2300	Italian, French, German, English (2145-2300)	12005
0500-1023	Arabic	15055
1515-1600	Dankaly	15055
1023-2330	Arabic	15090
1845-2145	Eibo, Hausa, Arabic	15135
0805-1455	Arabic	15175
0200-1455	Arabic	15475
1515-1845	Arabic, Somali, English (1730-1845)	17665
1215-1630	French, Benghali, Indian, Urdu	17690
1900-2200	Wolf, Bambara, French	17690
2330-0200	Portuguese, Spanish	17690
1615-1845	Sosuto, Zolo, Portuguese	17785
0800-2030	Arabic	17905
1030-1600	Arabic, Pushto, Persian, English (1315-1430)	17920
2000-2130	Yorba, French	17920
0000-0045	Arabic	17930
1000-1900	Arabic	17950
1145-1345	Indonesian, Malayan	21440
1915-2145	Folani, English (2010-2145)	21440
1645-1945	Shona, Sandbeli, Mianga, Linghali	21585
1400-1500	Siami	21615

VOICE OF FREE KOREA

The present schedule of the Voice of Free Korea, in Seoul, South Korea, is as follows:

GMT	Language	KHz
0230-0300	Spanish	15430
0300-0400	English	15430
0430-0530	English	15430
1530-1600	French	15430
0600-0700	English	15130
0700-0730	French	15130
5000-0530, 1100-1130	English	9640
2100-2130	English	9640
0800-0830	English	9640
1445-1500, 2145-2200	Russian	9640

an inverted-L aerial. The transmitter on 11910KHz has 7,500 watts, and the aerial used is a 3-wire folded-dipole.

According to Sofyan Alty the station is keen to receive reports from listeners. He said, "We would appreciate further reports regularly so as to strengthen our friendly relations . . . by radio."

SUNSPOTS DECREASE

The monthly sunspot count shows a decrease, showing that we have now passed the maximum period of the 11-year cycle. As a result broadcasters will be looking to the lower frequency bands in the future on which to carry their programs. The available data show that for June the average was 114 and the predictions are as follows:

July	110	October	107
August	109	November	106
September	108	December	105

NEW 13M BAND SIGNALS

ECUADOR: Radio HJCB in Quito is planning to use the 13M band for the first time, later this year. The frequency of 21475KHz will be used to carry the "Ecuadorian Echoes" program to Europe at 2100GMT.

NIGERIA: Radio Nigeria at Lagos is using the new 21455KHz channel from 0545GMT to 0730GMT. The station has been heard in Europe with a program preview at this time, and at 0600GMT news in English is broadcast. The transmission schedule is read at 0545 in French, English and Arabic. Lagos is also heard using the frequency of 21590KHz in English 1745-1900 and 2130-2205GMT.

NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times listed are Greenwich Mean Time, add eight hours for Perth, 10 hours for Sydney and 12 hours for Wellington time. Frequencies are listed in Kiloherts (KHz).

DX SPECIAL FROM BONAIRE

Trans World Radio at Bonaire over PJB has a weekly DX program which is on the air for listeners as follows:—

Friday 2100GMT	15255KHz
Sunday 0335GMT	9695KHz
Friday 1205GMT	11820KHz

The DX Special Editor is Al Stewart, who compiles the program. The Monte Carlo station of Trans World Radio also has been heard with its program on Saturday at 0610GMT on 7295KHz.

EXPANSION AT RADIO PAKISTAN

Radio Pakistan has signed a contract with the U.S.S.R. for the supply and installation of five transmitters for East and West Pakistan, reports the "Pakistan Times." The delivery of the transmitters will commence next year. The new stations will include one on medium wave with 1000KW, at Islambad, West Pakistan, and another with the same power for Dacca, East Pakistan. A 50KW medium-wave transmitter is to be located at Quetta, West Pakistan, and two transmitters of 100KW each for short wave will be at Dacca, East Pakistan. The two transmitters of 1000KW are intended to cover East and West Pakistan, as well as serving the off-shore island groups.

LATE NEWS

Transmissions from Vienna, Austria, to Australasia from September 1 will be 1000-1200GMT on 17885KHz. Radio New York World Wide service to Europe is 17730KHz from 1600-2000GMT and from 2000-2200GMT on 17760KHz. Two new stations on medium wave are projected for Hawaii to use 1090 and 1570KHz. The station to operate on 1090KHz will replace the now defunct KHAI, Honolulu.

FLASHES FROM EVERYWHERE

EUROPE

NORWAY: Radio Norway, Oslo has introduced an additional transmission beamed to North and South America. The broadcast is 0100 to 0230GMT and on 11725, 11850 and 11860KHz. A new transmission in Spanish is carried for Spanish seamen on Norwegian ships to supplement its regular transmissions to the South Atlantic.

ROMANIA: Radio Bucharest is on the air for Europe, in English;

GMT	KHz
1300-1330	15250-17850
1930-2000	11945, 15250
2230-2300	9570, 11940
For Africa and Asia	
1500-1530	11810, 15380, 17850 17775

U.S.S.R.: Radio Peace and Progress, from Moscow, which is broadcast in various languages in addition to the normal foreign language service from Moscow, can now be heard in Yiddish at 1500GMT on 17880KHz.

AFRICA

NIGERIA: The Voice of Nigeria, Lagos has a transmission to Asia on 17735 in English, 0545-0730GMT, according to Sally Voron, Coogee, N.S.W. The same program is broadcast to Europe on 15155. A transmission in English to Europe is on 15330KHz at 1500-1600GMT, while a further transmission to Europe 1700-1900GMT on 15255-KHz.

TANZANIA: Radio Tanzania has extended its External Service and now begins in English at 1700GMT on 15345, reports "World Radio Bulletin."

NIGER: Radio Niger noted on Sundays at around 0705 on 9705KHz. Heard with a selection of piano music and announcements in French, in the break of Radio Free Europe transmission.

BOTSWANA: The 100KW transmitter of the former BBC relay station at Francistown will be put into service this month from Gaberones. The station will use 4835 and 7295KHz the same channels as used when relaying the BBC World and African service beamed to Rhodesia. The transmitters will be used in parallel with the normal service of Radio Botswana.

BURUNDI: "La Voix de la Revolution du Burundi" is using 6140KHz, and is on the air 0400-0530, 1000-1300 and 1530-2100GMT. On Sundays the schedule is 0400-2100GMT.

SENEGAL: Radio Senegal, Dakar, has issued a new verification card, multi-coloured with photographs of native instruments. The card shows the following frequencies; Senegal Inter is on 15115KHz (100KW), 9720KHz and 4890KHz (both 4KW). National Network is on 7210KHz and 4890KHz (both 25KW). The address is P.O. Box 1765, Dakar. Network 3 uses medium wave only, and Network 4 is on 6070 and 3336KHz (4KW). The address for Network 3 and 4 is P.O. Box 173, Ziguinchor, Senegal.

ASIA

MALAYSIA: The Voice of Malaysia at Kuala Lumpur has revised its overseas services and now operates to the following schedule.

English	
GMT	KHz
0645-0845	6175, 11900, 15280.
Mandarin	
1400-1600	6175, 11900, 15280.
Indonesian	
0900-1400	6175, 11900.

The program in Indonesian is relayed by Radio Malaysia at Sabah, from 0900 to 1100GMT on 570KHz medium wave.

KUWAIT: Radio Kuwait has been conducting test transmissions over the Kuwait Broadcasting System, P.O. Box 397, Kuwait. The frequency was 21450-KHz and reception was for the periods 1630-1730, while another channel 21525KHz has been used on a test basis from 2200 to after 2400GMT. A report to "BBC World Radio Club" lists reception at 0700GMT also on 21525KHz. A further test in Arabic at 1400, with close down 1500GMT, is also reported.

PHILIPPINES: According to a verification letter, the Voice of the State University (DZUP) is operated by the University of the Philippines and broadcast mainly in English at 0900-1300 on Monday to Saturday, on 7160KHz (DUH9) and on medium wave on 1410KHz on DZUP. The Japanese Short Wave Radio Club says the station welcomes reports to: The Voice of the State University, University of the Philippines, Quezon City, Philippines.

MALAYSIA: Radio Malaysia has been heard on the new frequency of 5965-KHz, and has been heard with good signals with the Malay program around 1130GMT. Bob Padula, of Melbourne, Victoria, reports Radio Malaysia, Sabah on 4970KHz noted with English at 1415GMT.

PAPUA-NEW GUINEA STATIONS

The full list of stations operated by the Australian Administration in Papua-New Guinea is as follows:

Location	KHz	Call	Watts
Goroka	2410	VL9CG	250
Mount Hagen	2450	VL9CH	250
Samarai (Milne Bay)	3235	VL8AS	250
Kerema	3245	VL8BK	250
Daru	3305	VL8BD	10,000
Kieta (Bougainville)	3322	VL9BA	2,000
Wewak	3335	VL9CD	10,000
Rabaul	3385	VL9BR	10,000

The Australian Broadcasting Commission operates a shortwave service from Port Moresby relaying station 9PA, 1250KHz.

Location	KHz	Call	Watts	
Port Moresby	3925	VLK3	10,000	2000-2200, 0730-1400GMT
Port Moresby	4890	VLK4	10,000	2215-0715
Port Moresby	4890	VLT4	10,000	2000-2200, 0730-1400
Port Moresby	9520	VLT9	10,000	2215-0715

BROADCAST BAND NEWS

AUSTRALIA: The Australian Broadcasting Commission has released its plans for the further expansion of its medium wave services, reports "Australian DX News," which also indicated the year in which the transmissions are expected to commence.

Call	Location, Power, and Frequency
2ML	Murwillumbah, N.S.W., power increase to 400 watts, 560KHz (1968/69).
2CO	Albury, N.S.W., to move to a new location (69/70).
3--	Portland, Victoria, new regional station (69/70).
4--	Charleville, Qld., new 10KW transmitter (69/70).
4--	Cloncurry, Qld., new 50w transmitter (70/71).
4GM	Gympie, Qld., power increase to 2KW, 1570KHz, (69/70).
4--	Hughenden, Qld., new 50w transmitter (70/71).
4--	Mossman, Qld., new 200w transmitter (70/71).
4SO	Southport, Qld., power to 2KW, 1590KHz (69/70).
4--	Weipa, Qld., new 50w transmitter (69/70).
5--	Ceduna, Sth. Aust., new 200W transmitter (1971).
5--	Naracoorte, Sth. Aust., new site of 5PA. Penola and power boost to 10KW, 1160KHz.
6BS	Busselton, W. Aust., 2KW, 760KHz, (late 1968).
6--	Manjimup, W. Aust., new regional station.
6WN	Perth, W. Aust., to increase to 50KW, 810KHz.
6--	Wyndham, W. Aust., new regional station.
6DB	Derby, W. Aust. 2KW 870KHz. now in operation.
6PH	Port Hedland, W. Aust., 2KW now in operation.
6BE	Broome, W. Aust., 670KHz 50w now in operation.

MEDIUM WAVE STATIONS

The Voice of America now operates the following stations on the broadcast band:

GMT	KHz	Location
1100-1630	760	Vietnam (50KW)
0430-0630	791	Greece (50KW)
1030-1700		
1500-1530	920	Philippines (50KW)
1015-2400	1140	Philippines (1MW)
1100-1700	1178	Okinawa (1MW)
2300-0400	1180	Marathon, U.S. (50KW)
1200-1400		
1300-0600	1196	Germany (300KW)
1600-2400		
0300-0730	1259	Rhodes (150KW)
1400-2315		
1130-1630	1580	Thailand (1MW)

PAPUA, NEW GUINEA

Goroka, Lae and Madang are to have 2KW transmitters by 1971.

HONG KONG: British Forces Broadcasting Service is operating now from Hong Kong, using 1250KHz and the power of 2KW, according to "Sweden Calling DXers."

NIUE: Radio 2ZN, Niue, is now being heard in New Zealand on 550KHz at 0600GMT. At this time a news bulletin in English is broadcast, and at 0610GMT the program continues in Niuean. The full schedule of the transmission is 0500-0750GMT, Tuesday to Saturday. The transmissions in Niuean time is 6.00 to 8.50 p.m. Monday to Friday. 2ZN has the power of 200 watts.

INTERNATIONAL WATERS: Press reports indicate the Belgium is to have its first off-shore radio station. Called Radio Marino, it will use two frequencies with separate programs in French and Dutch.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- *Please give your name and full postal address, including the State and Postcode.*
- *Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.*

MULTIBAND TUNER WANTED: Have you published any articles on multiband receivers which can be plugged into the auxiliary inputs of a stereo amplifier. This should interest a number of people as the receiver would not need an audio amplifier, which would cut down on the cost of construction. **(R.G.H., Doveton, Victoria.)**

● We have not described a tuner such as you mention in recent years, as we have found that a multiband tuner is not favoured by short-wave listeners, who prefer to keep their SW facilities separate from their audio equipment. We did, however, feature the dual-wave "Super Tuner" with RF stage in June, 1948, and the dual-wave "Playmaster No. 1" (without RF stage) in February, 1952. Both required dual-wave coil brackets which would not now be available. However, circuit information would be available through the Query Service for the standard charge of 20c each.

AUTO TEST EQUIPMENT: I wish to build my own automotive test equipment rather than buy "tailor made" which is too expensive for a small workshop. There does not seem to be anything available in the way of magazine articles. I have built some of your projects over the past seventeen years and am deeply in debt for the understanding your magazine has given me in electronics. **(J.M., Beaudesert, Qld.)**

● We have seen isolated articles on automotive test equipment in overseas magazines but have no list of references which we could quote. In our own magazine, we would remind you of the automotive voltmeter described in March and April, 1963, and August, 1965. A tachometer and dwell meter for service stations was described in October, 1964.

POWER LINE INTERFERENCE: I was interested in the letter in Forum in the May issue concerning noise from power lines, particularly S.W.E.R. lines. For the past 18 months or so I have experienced severe interference from this type of line. The trouble, though investigated, has not yet been located. Noise sometimes rises to S9 on 80 metres and is most severe on the Country Fire Authority network on 2620MHz. At times it can be heard from the broadcast band to 10 metres. I have called the S.W.E.R. line many names — but never "Ham's Delight." It may well be, of course, that the trouble is in the transformer. **(K.H. VK3—, Kyneton, Vic.)**

● Thank you for your comments, K.H., and we are sorry we connot offer any practical help. If the people on the spot cannot track it down, it must be a tricky problem. Perhaps the Country Fire Authority could bring more pressure to bear — through your local Federal and State members if necessary — to have a more concerted effort made to solve the problem. The more often complaints like this are brought to the notice of members of Parliament the better the chance that we may eventually win legislation to control the problem.

METEOROLOGY SYSTEM: I am interested in constructing a wind direction and speed indicator of the remote indicating type, in which one meter shows speed and another shows direction. The sensing units are mounted in the open and the indicators inside the home. **(J. F. H. Hount, Mt. Gambier, S.A.)**

● By co-incidence, your letter arrived shortly after we had finished preparing our "Reader Built It" page with details of a scheme almost identical with that you describe. This appears in our June issue, on page 83. The anemometer used was originally described in our April, 1965 issue. Unfortunately, we omitted to publish the full name and address of the contributor on this occasion, and if you are interested in contacting him, he is Mr D. Wright, P.O. Tarpeena, S.A. 5277.

When writing, please make sure your address is complete, including the POSTCODE. Addition of the latter will ensure minimum delay in handling your letter. Also make sure that your address is legibly written or, for preference, PRINTED. A significant number of letters are returned to us each month because the original address was incomplete or illegible.

MIXER-COMPRESSOR: Many thanks for producing a solid-state Volume Compressor (June 1968), but I am disappointed that you did not describe it as part of a complete mixing unit suitable for serious P.A. or recording enthusiasts. Would you consider describing a project along these lines? **(D.J.O'B., Williamstown 3016.)**

● The compressor was developed as a project distinct from our previous mixers, D.J.O'B., because the two types of circuit seemed quite distinct in function. However, it would be quite feasible for those who require both facilities to operate both together, with the output from the mixer taken to the compressor before passing to the recorder or main amplifier system. Because the signal-to-noise ratio of the compressor is not quite as good as that of our mixers, the combination may not be suitable for the most demanding recording work. But it would be adequate for most normal applications requiring compression.

XYLOPHONE INTERFERENCE: Tonight, about 7 o'clock, my son started practising on his xylophone in a bedroom, about 8 to 10 feet from the TV receiver and nowhere near the aerial. While he was playing, I noticed that sound lines were appearing on the TV screen which varied in intensity with the loudness and pitch of the note being played. For a while, a trace of the sound could be heard in the loudspeaker but this disappeared after a while. Fortunately, my wife and daughter saw the effect also and I demonstrated it to my son. How could this come about? **(R.A., Kensington Park, S.A.)**

● Our tip is that one of the bars in the xylophone or a piece of metal somewhere in the house was vibrating with the sound and that it also happened to be of such a length and in such a position that it was modifying slightly the field strength of the sound signal from the particular TV station. The set may also have been tuned to favour the sound signal somewhat, making it more than usually sensitive to variations in sound signal field strength. Many seemingly weird things like this have been noted during the history of radio and television but most of them are capable of some kind of explanation invoking ordinary electronic laws. Incidentally, we have assumed that the instrument concerned was a purely acoustic one. If it involved any kind of an amplifier, a more likely explanation would be that the amplifier was unstable, radiating a RF signal which caused interference in the TV receiver.

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

REPRINTS: For a 20c fee, we will supply circuit data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuit data will be answered more speedily if the circuits are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to 6 months old there is a surcharge of 5c. On issues from seven to 12 months old the surcharge is 10c. Over 12 months, it is 20c. Package and postage is 10c extra in all cases.

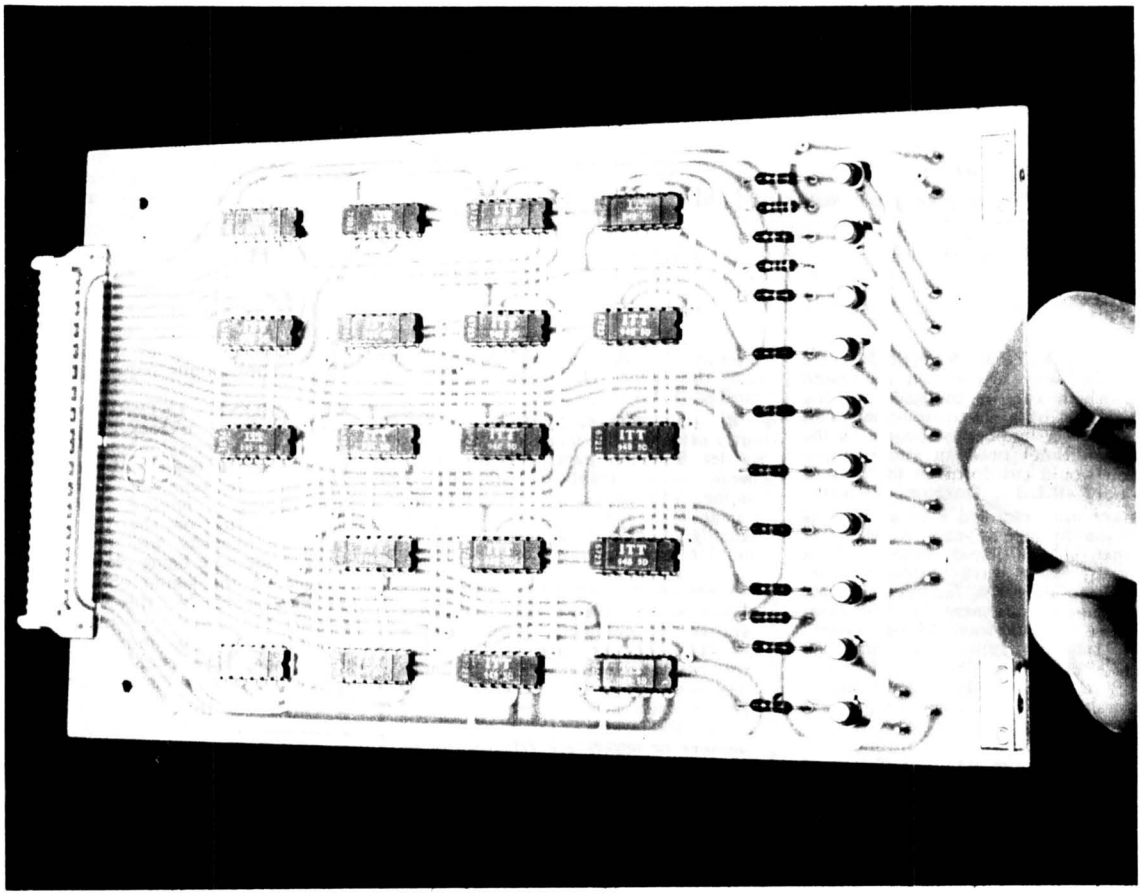
REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W., 2001. Other correspondence should be directed to The Editor. 9/67



ITT 930 series DTL now available from stock —backed by STC engineering advisory service

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ANSWERS TO CORRESPONDENTS – continued

BROADCAST STATIONS: I would like to bring to your notice two minor errors made in compiling the list of Australian Broadcast Stations (Electronics Australia, January, 1968, pages 96 and 97.) The call signs 5KA (1200KHz) and 3CV (1440KHz) are incorrect. These should be 5KZ and 3CY respectively. **(H.H., Bandiana, Vic.)**

● Thank you for pointing out the inaccuracies, H.H., we will make sure they are corrected in the 1969 stations list.

LIKES E.A.: This letter is written solely to comment on your publication which I have been buying since it was R&H at 6d. a copy. With the change of name the magazine has improved vastly and is the best 30c worth one can buy. I am not now actively engaged in the industry but I find each issue interesting. There has been a big improvement in the quality of the advertising and the advertisers are to be commended for the amount of technical information conveyed. I note also your patience in "Answers to Correspondence" in replying to repetitious questions of an elementary nature. I can't suggest any improvements except to delete the record reviews, but this won't be done, because it is one of W.N.W.'s hobby horses. **(V.S., Croydon, Vic.).**

● Thanks for all the nice remarks. Hobby-horse or not, record reviews have a strong following, including the devotional! We guess that quite a few readers would say, keep the reviews and cut out all the adverts. That's really unlikely to happen, unless we decide to commit economic suicide.

WARTIME TRANSCEIVER: I read most copies of E.A. and find them useful in helping me to understand electronics. As yet I have not seen an article on the modification of the No. 19 wartime radio set. If you cannot help, perhaps a reader may be able to put me on to a copy of "Practical Wireless" for March, April and May, 1960. The Orange District Radio Society — VK2AOA — has access to such a radio which is sometimes used as a standby set. **(S. J. Pascoe, Wolarol College, Orange, 2800).**

● We cannot help you with the information you require and we have some doubts as to whether the reference is right. However, we are publishing your name and address so that any reader who has the information to hand will be able to get in touch directly.

PROJECTOR QUERIES: I am interested in all information regarding a new quartz lamp which appeared in "Scientific and Industrial News" of your March, 1968, issue. I have approached G.E. Co. in this State without success. Also, I recall that you had a circuit printed in your magazine for an amplifier for a 35mm sound projector, and also in a later issue a transistorised pre-amp for same. Could you please inform me what is available in circuits, parts lists, etc? **(J.E.G., Highbury, S.A.)**

● The information given in the "News" item was all that we received on the subject. We suggest that if you require more information you should contact Australian General Electric Pty. Ltd., 103 York Street, Sydney, N.S.W. 2000. We published an article describing a 16mm and 35mm optical sound adapter (for use with a separate amplifier) in February, 1961. In April, 1961, a 16mm optical sound amplifier was published as a follow-up article. Finally a transistorised optical/magnetic preamp for sound projectors (16mm and 9.5mm only) was described in April, 1967. Copies of these articles are available through the Information Service for 20c each.

ADVERTISEMENTS: I have noticed in the past some correspondents have suggested that you should intersperse advertisements between technical articles to facilitate the removal of these articles for storage. I realise that this may be difficult to anticipate in advance but, with the large volume of advertisements carried, this should be no special problem. In the July issue, for example, you could . . . **(B.D. Brisbane).**

● Your observations ignore two vital facts. One is that E.A. is not laid out and produced as a single operation, but the work is spread over a whole month. Firm decisions have to be made about the placement of articles and advertisements in some sections of the magazine before other sections are anything like complete. To re-shuffle pages later can delay and increase the cost of production to such an extent that we must have a very strong reason for doing so. The other point is that the placement of advertisements in a magazine is governed by matters of procedure, contract and equity and there are definite reasons why most full and half-page advertisements are placed on the left, why some are facing pages, why some have colour, etc. This is not to suggest that we think the end result is always above criticism; there are usually things about a finished issue that we would have preferred to be otherwise. Equally, there are usually reasons why they couldn't be!

MIXERS: Could you tell me where I can get a book on mixers, their operation, and construction? **(D.M., Canberra, A.C.T.)**

● We described 4-channel mixer units in February, 1966, and February, 1967. Both are solid-state designs, the latter including FETs. Both articles give a simple description of their operation and include all necessary constructional details. Copies of these articles may be obtained through the Information Service for 20c each.

SIMPLE RECEIVERS: I am a teacher of Aboriginal boys studying radio. They can assemble the items in a commercial electronic kit. I would like to know if you have any simple projects for transistor receivers that could be used by these boys. Their knowledge is limited to knowing what the parts are and using the resistor colour code. **(P.J.McI., Berimah, N.T.)**

● The Basic Radio Course, which may be of general assistance to you, has a simple transistor receiver project in one of its chapters. Alternatively, an article entitled "Simple Crystal and Transistor Sets" published in March, 1963, should meet your requirements. The Basic Radio Course is available for $1.60 (including postage), and the article costs 20c. Both are available through the Information Service.

AMATEUR EQUIPMENT: I have been a reader of E.A. for many years and would like to congratulate all concerned for producing a publication of such high standard. I would like to make a suggestion: How about a series on a complete amateur station for the 52, 144 and 420MHz bands. Converters should be crystal controlled, capable of covering the whole of the bands and built on Veroboard. The transmitters should have about 25 watts output on 52 and 144MHz and 15 to 25 watts on 420. The transmitters could be rack mounted. Modulator would be about 18 watts. This would be of great interest to readers interested in VHF and UHF. **(L.G., Brighton, Vic.)**

● Thank you for your suggestion. From this point on it starts getting involved. Valve or transistor? AM only or do we have to think in terms of SSB? Or FM? Or some of the other schemes which have come along lately to make things difficult? The trouble is that an amateur or would-be amateur can't build what happens to appeal to him personally. He has to conform to what is going on in the bands—or else starve for want of contacts!

ANSWERS TO

EXPOSURE METER: Have you ever produced an exposure meter to be used with enlargers? I am very interested in such an instrument which could do away with test strips and guesswork in general. **(Z.P., Rosalie, Qld.)**

● We have considered such a project on several occasions. However, it is difficult to achieve a sufficient order of sensitivity while restricting the measurement to a sufficiently small area of the projected image. This is rendered even more difficult when one considers that the densest part of the negative is one of the most important levels to be measured. And, even assuming that all the technical problems are solved, we are not convinced that it would be a complete answer. Negatives made on different parts of the film characteristic curve are likely to need different treatment, regardless of measurement. Add to this the need to consider the purely artistic aspects of the print and one has a good case for the subjective approach. At best, we imagine that a meter would provide "a place to start from."

AMATEUR LICENCE: In your June issue (Answers To Correspondents) you said that the minimum age for issue of an amateur licence (A.O.C.P.) was 16 years. This statement is incorrect, as the minimum age was reduced to 15 years from the beginning of this year. One can now sit for the A.O.C.P. or A.O.L.C.P. licence examinations at the age of 14 years and obtain the licence at 15. This information is contained in the P.M.G. handbook "Regulations for operators of radio stations in the amateur service" obtainable from the P.M.G. Radio Branch for 30c. Your correspondent may also be interested to learn that he can obtain further information about the Youth Radio Scheme by contacting the S.A. division of the Wireless Institute of Australia, Box 1234K, G.P.O. Adelaide 5001 or the Elizabeth Amateur Radio Club, Youth Radio Officer, P.O. Box 8, Elizabeth, 5112. **(P.P., Elizabeth East, S.A.)**

● Thank you for drawing our attention to the matter of reduced age for issue of the amateur licences, P.P. At the time we prepared our reply to our correspondent we had not seen the latest P.M.G. regulations handbook.

CONVERTER AND VARIOMETER: Has your magazine ever published an article about a converter for use with an ordinary BC/SW receiver? If so, what is the date of issue of the magazine concerned? After reading a small paragraph about a variometer, I built a small one which gave much stronger reception and greater sensitivity. Have you ever published anything about the variometer, and is its use to be recommended? **(R.W.A., Cottesloe, W.A.)**

We are not sure what you have in mind, a VHF converter, or an ordinary short-wave converter which will give better performance than the existing short-wave facilities on your receiver. If you would be more specific, we could see whether we have anything to approximate your requirements. A small variometer could not boast very good characteristics as an inductor and we would have reason to doubt the merit of the conventional circuit with which you apparently compared it. In the long run, the performance of a tuned circuit is governed by certain basic things like L/C ratio, "Q" and impedance levels; the use of variable L or variable C is not in itself a guarantee of performance.

QUESTIONS ON STEREO: Earlier on you were kind enough to answer some questions about stereo equipment. Can I ask you a couple more? **(D.G., St. Ives, N.S.W.)**

● Some of your questions will have already been answered in recent "Audio

CORRESPONDENTS—continued

Topics" articles. Briefly, however, audio equipment does not need to have a response outside the range of your hearing. Your loudspeakers covering to 17KHz are probably better than your ears and there is absolutely no need for them to go to the figure of 35KHz mentioned for the amplifier. It would be better if they went down below 50Hz but this usually involves a larger, more expensive system. It is in order to use loudspeakers with a lower power rating than the amplifier, provided that they are used in situations where they are not likely to be run at an excessive level. A couple of 10-watt stereo loudspeakers will provide very loud sound in a domestic situation and, provided they are operated at a likely and commonsense level, it wouldn't matter a great deal whether the driving amplifier was rated at 10 watts RMS or 50. A 2-way loudspeaker system is one involving two loudspeakers, usually a bass-and-middle unit and a tweeter; a 3-way system would use three loudspeakers, one for bass, one for mid-range and a tweeter for the high frequencies. The small stereo cassettes, as recently reviewed, are capable of pleasant sound and can be played through a large system. Their main lack at the moment is in the high frequency region above about 7KHz. The Philips players seem to be good in terms of wow and flutter but some of the cheapest cassette players leave a good deal to be desired in this respect.

ELECTRONIC ORGAN: I read with great interest the two articles on the monophonic organ. In the December, 1976, article it was mentioned that you planned to take a closer look at both monophonic and chord type organs. After another look at the monophonic organ in the January, 1968, issue I was wondering when you expect to publish information on a small chord type organ. I am interested in an instrument similar to those used by various pop groups. I have read your magazine for many years and have always found a wealth of interest, but I would like to see more articles about electronic musical instruments. This field has hardly been touched except for the electronic organ of 1962 and the latest monophonic organ. In the meantime could you advise me of any publications which deal with solid-state electronic organs and electronic musical instruments. **(P.C.C., Launceston, Tas.)**

● There is a possible misunderstanding here and, having re-read what we wrote in the December 1967 issue, we must plead guilty to contributing to it. In the particular article we were seeking to differentiate between monophonic instruments and those capable of playing chords and we referred to the latter as a chord-type organ. In fact, the same term is used to describe an instrument in which buttons are used for the left-hand, as with an accordion, to play a variety of pre-arranged chords. It has never been our intention to become involved with this type of instrument, since the mechanical and electrical complications would most likely present greater problems for the would-be home constructor than a normal keyboard. We have not forgotten the matter but, because of pressure of work, have not been able to pursue it further. In the meantime, of course, imported electronic organs of all sizes are becoming cheaper and more plentiful and this must affect the incentive for home construction.

SIMPLE TRANSMITTER: Would you please publish plans of a simple transistorised transmitter for my friend and me? We are both 13 years old. **(J.C., Tallangatta, Vic.)**

● Sorry, J.C., but your request presents too many problems. In the first place, it is obvious that you plan to use a transmitter without a licence, since the P.M.G.'s Department is unlikely to issue a licence to persons of your age. Penalties for the use of unlicensed transmitters include fines, gaol sentences, or both, plus confiscation of equipment. Apart from this, the simple request for "a transmitter" is far too vague. Assuming that you held a licence, we would need to know the conditions of your licence, such as the frequency on which you were permitted to operate, the power allowed, the transmission mode, etc. Finally, it is unlikely that we could help unless the licence was an amateur licence, since most of the transmitters we have described have been of this type.

CRYSTAL SETS: Have you printed any articles about 2-diode crystal sets or at least sets with more than one diode? Is there any type of crystal set that can pick up more than one band? **(P.G., Yallourn, Vic.)**

● Although a set could be built using two diodes in a full-wave type configuration, we have not published such a design nor have we any plans to develop such a set. Its advantages would be debatable. Crystal sets are normally not sensitive enough to receive many short-wave stations and, therefore, are usually made for broadcast band reception only.

COMPARATIVE TESTS: I think that "Electronics Australia" could improve its "Trade Review" section by running direct comparisons between turntables, cartridges, loudspeakers, etc. It would cost money, but could be offset by raising the price to 40c which we calculate would bring in $5,500 per annum . . . Also a lot of your readers are young people and I have never seen a review of a Beatles LP, even though three have been released since I started reading the magazine. **(G.C., Condell Park, N.S.W.).**

● Things wouldn't be quite as simple as you apparently imagine. When a journal operates in this fashion, products are not normally submitted by the manufacturers with a request to review. The products are bought though normal channels, verified as representative examples, then exhaustively tested and publicised, whether the manufacturer likes it or not! If the findings are contested in these circumstances, there can be legal involvements and it is not for nothing that various publications which carry such material are distributed to member/subscribers, as distinct from casual purchasers. There would be far more to testing loudspeakers than the kind of listening test that you carried out. We note your observations about the Beatles records but, to the present, we have not extended our reviews to take in the "pops."

AUDIO COLOUR: A few weeks ago I came upon an advertisement in an American magazine for "Audio-Color" which is claimed to add a visual dimension to musical enjoyment. As this rather intrigues me, I was wondering if it was possible to describe a similar unit in your excellent magazine, so that I could make this unit. **(C.S., Adelaide, S.A.)**

● We have had a similar unit brought to our attention before, but we have no immediate intentions of developing one.

STATION IDENTIFICATION: Could you advise me of the call sign and address of a station in Vietnam that broadcasts in English (American announcer) between 1.30 a.m. and 2.00 a.m. South Australian time, on approximately 550KHz? **(W.A., Berri, S.A.).**

● This type of query is outside the scope of the Information Service, and should properly be addressed directly to our DX contributor Art Cushen, whose address appears in the "Listening Around the World" pages of every issue.

SOUND PROJECTORS

Cinevox Prefect and Hamour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

from $90

CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

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Post 10 cents.

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Contains these lenses:
1 Lens 1in Focus, 1½in diam.
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1 Filter Lens, 1 Graticule,
1 Lampholder. **$1.85**
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P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

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240 volt A.C. Input.
Each Battery Charger will charge either 6 or 12 volt batteries.

2 amp. without meter,	$13.75
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1½ to 3 volts DC, ideal for model boats, cars, planes, etc. Strong torque. Only
65 cents each or 10 for $4.00
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(2-way radio) R.C.A. America RT 68. 24 volt, operated 10 watt output 38-54 meg/cycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs. step 10 channel per meg/cycle with power supply. Leads, mike and headphones $90.00. 60c cartage to rail. Freight payable at nearest attended railway station.

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TRANSCEIVER

(2-way radio) 62 set ideal small ships. Hams, etc 1.6 to 10 megs. Crystal locked or B.F.O. controlled 5 watt output. Complete with antenna, headphones and mike but not air tested. $60, air tested $80. Not tested incomplete (without accessories $25). 60c cartage to rail. Freight payable at nearest attended Railway Station.

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Low impedance moving coil fitted with rubber muffler to reduce external noise. fitted with press to talk, dynamic hand microphone. Ideal for use with all types of transceivers, $3.50 pair. Same with black felt muffler, $4.50 pair.
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EMI TAPE at a fraction of the Retail Price, direct from one of Australia's leading Broadcast studios.
Used in good condition.
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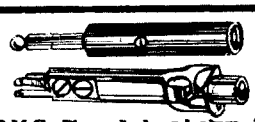
300ft, 3in spools, 65c, post 13c



P.M.G. Phone Jack and plugs, 25c each, 45s the pair.
Post 7c.

NIFE CELLS

1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

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1.2 volts 15 AH, 8in x 4in x 2in, $3.95
2.4 volt 10 AH, 6in x 2½in x 2in, $2.50.
Post, N.S.W., 30c; Interstate, 40c.

WALKIE TALKIE TWO WAY RADIOS

P.M.G. Approved Citizen Band.
6 transistor: $50 per set of 2.
9 Transistor, $75.00 per set of 2.
10 Transistor, $98.00 per set of 2.
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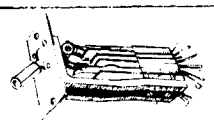

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Special discount for quantity

807	75c	X61M	$2.20
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89	$1.00	1H6G	30c
12SA7	$1.25	832	$5.00
5U4G	95c	6F13	75c
77	$1.00	6AK5	$1.50
EF50	35c	6X4	$1.00
6U7	75c	6F8	75c
V1103	$1.00	12SK7	50c
VH120	75c	VR1120	50c
IL4	$1.00	VR118	75c
5Y3	$1.75	VR65	25c
6C4	50c	VT4C	75c
CV2184	$2.95	AU5	$1.00
2 x 2	75c	80	$1.25
6AG5	90c		
12AU7	$1.00	6AK5W	$1.50

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$5.75

60 magnification with a 60mm coated objective lens. With tripod.

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As illustrated.

Postage, 95c; Interstate $1.20.

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30 x 40 with Tripod

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EX ARMY TELESCOPES

4 x 40 Handley	$6.50
7 x 40 Otway telescope.	$9.85.

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I.R.C., brand new ½w., 1w, 2w, tolerance between 1 and not exceeding 5 per cent including 1K, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 40c each, 50 assorted different values for only

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100 to 150 m/cs.

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(240 Vac supply for AT 5-ARB) suit most types of Disposal transmitters and receivers outputs 250 volt, 10ma, 550 volt 200ma, 300 volt 100ma, $30.00.

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21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ¼ mile). $7 per coil.
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Steel ex-P.M.G. Height 45in x 27in x 34in, will make ideal test bench. $10.
$1.00 cartage to Rail.
Freight payable at nearest attended railway station.

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9ft in seven sections.

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Gramo. Motors. New. Made in U.S.A. 4-speed .240 volt A.C. 50 cyc. Only $2.75 each.
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70 ohms 4 positions can be motor driven completely waterproof 70 ohms type connectors. Housed in metal case 9" x 8" x 8" $5.00 each. Post N.S.W. 70c. Interstate $1.20.

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Brand new Slocombe, 1in-2in, $7.85. Post, 32c.
VIBRATORS, 6 volts, 7-pin, 75c each.
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INSTRUMENT TRIPODS, sturdy, wooden frame. Telescopic. Extend to 4ft 6in $13.00
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10 x 50	$23.07
12 x 50	$23.95
20 x 50	$26.50

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P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

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Ex A.M.F. with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station.

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639B Western Electric, top grade, original cost $250. Ideal Broadcast Studio, music recording, Church and play recording, etc. Fraction of original cost.
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Supplies all necessary voltages to operate 522 transceiver from 240 VAC. Complete and ready to plug in, $30.00.

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.00. We haven't got time to sort them, so you reap the benefit.
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Plunger Type 12V 300M.A. Suit electric camera control, miniature trains, radio, etc.
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200 Mill. amp., 24 volt, 1/8in push movement.
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TELEPHONES

Sound Powered. Can be used as Microphone and Receiver. New. With 50ft cable. $3.85 pair.
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A.W.A. or S.T.C.
Two-way radio. 75-80 M/cs.
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MINIATURE CRYSTAL EARPHONE

With Cord and Plug.

75c.

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With 4in Vu. meter GLORAD. Complete with Portable Power Converter. 600 ohm balanced input and output. Ideal for outside broadcasting, etc.

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Ex-A.B.C., consisting of low resistance 8in speaker in Acoustic Labyrinth Baffle Box, complete with 10-watt amplifier, 600 ohms plus 8dbm input, 240 volt A.C. operated.

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Types TR1934 100-125 meg/cys. and TR1935 125-150 meg/cycles. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.

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With 500Kc crystal up to 32 meg/cycles.

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BENDIX BC221 FREQUENCY METERS

Built-in 240 volt power supply, perfect condition.

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Subminiature 4-Transistor, Audio Push-Pull.

$7.00 Post 50c.

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SORRY, NO C.O.D.

ANSWERS TO CORRESPONDENTS—continued

DESIGN ASSISTANCE: Could you please recommend a photo-diode or a photo-transistor which is sensitive to light of low intensity, as I wish to make a viewfinder photometer for a reflex camera used in photomicroscopy? Could you suggest circuit alterations to the audio generator of December, 1967, allowing its use as an audiometer? **(T.S., Tenterfield, N.S.W.).**

● Sorry, but this request is outside the scope of the Information Service as detailed in the panel on the first page of "Answers to Correspondents" in each issue. In the circumstances, we regret that we cannot assist on this occasion. We would suggest that you contact one of the semiconductor manufacturers or suppliers (such as Mullard) for assistance with your photo-diode or photo-transistor problem.

CLOTHES WARMER: Why doesn't somebody market an electrically heated rack on which clothes can be hung to warm ready for wearing on cold mornings? **(J.C., Burwood, N.S.W.).**

● This kind of function is performed in hotels, motels and private homes, particularly in the colder overseas countries, which are equipped with convection heaters, towel racks, etc., operated in conjunction with the central hot water system. They are also very handy for drying underwear draped over them during the night! To keep clothes warm, however, an open rack needs to produce quite an amount of heat. It would not be cheap to operate and would rightly have to be regarded as much as a room warmer as a heated clothes rack. For higher thermal efficiency as a clothes warmer, an enclosed cabinet would be better but this would lead to the question of space and appearance. What about a small heater or even a suitably protected lamp operating inside the normal clothes closet or wardrobe?

A WORD OF THANKS: I would like to express my appreciation of the magazine in general, the information service in particular and for the "Audio Mixer" article, which I read a couple of days ago. It was just what I needed. There always seems to be something of interest in every section of the magazine, even the advertisements. Keep up the good work. **(E.H. Surrey Hills, Vic.).**

● And thank you for taking the trouble to write. We don't resent letters of criticism but it is refreshing to receive notes like yours from time to time.

ELECTRONIC READER: Can you tell me whether a device has been invented which will scan printed letters and convert them to an artificial voice? **(M.McC., Ermington N.S.W.)**

● A lot of concentrated work is being done throughout the world on the development of machines which can recognise printed characters for business machines, computers, etc. Major problems are involved, which may ultimately demand the adoption of more standardised characters than now appear in printed documents, books, etc. A lot of research is also going on in the realm of artificial speech but, there is a long way to go here also. For all practical purposes we can say that no such machine has been invented or is even likely in the reasonable future. It will be a long time before any machine can read ordinary books to the blind.

RECORD REVIEWS: Like E.A. of Lindfield, N.S.W. I would like to see space devoted to reviews of popular records. Also, I cannot understand why you do not feature more records from Deutsche Gramophon, as they seem to produce records of a very high standard. I would like to join the World Record Club but, as they do not advertise, I do not know what their address is. **(J.T., Hornsby, N.S.W.)**

● Thanks for your letter but we cannot see our way clear to review pop. records for the time being. We review records sent to us by distributing companies for the purpose. Some companies are very systematic, others don't get around to it. It's as simple as that. The address of the World Record Club in Sydney is: The World Record Club Pty. Ltd., 177 Elizabeth St., Sydney, 2000.

FIRE BRIGADE RADIO: From 1970, rural fire brigades in Victoria will change from HF to VHF communications on about 163MHz. Householders will require receivers to listen in the danger periods. Have you thought of presenting a transistorised version of the Fremodyne 4? The other alternative would be a converter for either AC or 12V operation, though I don't know whether the PMG would approve. Have you any designs for car radio boosters to pull in more distant stations or to improve the existing stations? **(P.B., Borradale, Vic.)**

● The changeover is part of an overall rationalisation of radiotelephone services, necessitated by increasing demands for more and more services in the available band space. The changes are costly to all organisations concerned, not only to the fire brigades. The question of equipping householders with monitor facilities would seemingly raise both legal and organisational issues and the more straightforward approach would seem to be to obtain co-operation of the local broadcasting stations to issue messages of an authorised kind. Direct monitoring might ensure speed in some cases but panic in others! No, we do not have anything in the way of a car radio booster. With a modern, well designed car radio, the gain and signal-noise ratio is probably near usable limits and additional gain would boost the signal and whatever is interfering with it by the same amount. Our advice would be to use the largest practical aerial, a suitable aerial cable to the receiver and make sure that the receiver input circuit is peaked.

THEATRE ACOUSTICS: Has E.A. ever constructed a microphone incorporating a dB meter to enable the acoustic response of a theatre to be measured? I intend to install the E.A. Audio Compressor in a 500-seat theatre. Would I need a C.R.O. to adjust it for best results? Can you suggest a source of graph paper, log v. linear, for plotting response curves? **(B.E., Augathella, Qld.)**

● We have never described the kind of instrument you have in mind, which is commonly referred to as a sound level meter or a noise level meter. Such an instrument would necessarily be a rather expensive unit, if only because it requires the use of a very high quality microphone. Even so, it would not tell you one of the things you really need to know about a theatre or hall, namely the reverberation time. An audio compressor can be very useful for making an original recording but we doubt the wisdom of using one with recorded material, particularly films, which will already have been monitored and compressed with a view to reproduction in a theatre. There could also be a problem in using a compression unit with a public address system, in that the maximum gain condition is likely to be limited by the onset of acoustic feedback. You would not need a C.R.O. to set up a compressor unit but be prepared to find that the range of automatic control which such a unit can provide will be a good deal less than it could provide if used in a recording chain. Graph paper normally has to be obtained from suppliers to stationers or draftsmen. We haven't bought any for as long as we can remember, the log/linear paper used in our published graphs being our own printing. ■

A NEW AF SIGNAL GENERATOR—continued

special setting-up of the oscillator bias the distortion level of a typical instrument will still be below 0.2 per cent over a major part of the frequency range.

Adjustment of the quiescent bias on the buffer amplifier may be necessary to ensure that the amplifier is capable of delivering maximum output without clipping. The easiest way of performing this adjustment is to connect an oscilloscope to the output of the instrument and to adjust the bias until the onset of clipping is symmetrical when the fine attenuator is turned to maximum (corresponding to somewhat more than 10V RMS). Bias adjustment is performed by alteration of the value of the high-value shunt in the bias divider of T5, as noted earlier.

Calibration of the output level meter circuit is best performed by connecting to the instrument output a high-impedance AC voltmeter of known high accuracy, such as a digital voltmeter. If a high-impedance meter is not available, suitable allowance will have to be made for the voltage division ratio which will relate the meter reading with the output level. Note that the meter calibration should be made at full-scale deflection for greatest accuracy, with the instrument set for sinewave output and the coarse attenuator set for the 10V range (i.e., the meter should be calibrated at 10V RMS).

It should be noted that the meter circuit calibration should be performed only after the buffer amplifier bias has been adjusted to permit the latter to supply 10V RMS without clipping. If the two operations were done in reverse order, the meter calibration might well be significantly in error due to the waveform distortion. ■

ELECTRONIC THERMOMETER

(Continued from page 61)

As may be appreciated from an understanding of the bridge circuit principle, maximum accuracy is obtained when the bridge is balanced since, in this condition, there is no current through the meter and the reading is virtually independent of battery voltage. The only effect of battery voltage variation in these circumstances is to vary the sensitivity of the bridge, or its ability to indicate that it is balanced. Thus, unless the battery has failed almost completely, the bridge will still indicate the precise condition of balance.

This thought leads naturally to the suggestion that, where one particular temperature only is significant — say 68°F in photography — we would achieve greatest accuracy by employing a centre zero meter, with circuit values so selected that the bridge will balance at the critical temperature. Thus even minor inaccuracies caused by voltage variation will be of little consequence, since they will be most apparent at values furthest removed from the critical value.

The only practical problem in this regard is the availability of a suitable meter, at least in the imported variety which we used for our laboratory model. They should be readily available in larger, more expensive types. Alternatively, some readers may already have a suitable type available from, say, a disposal source. Assuming it has the required sensitivity and that the movement works freely, it should be quite suitable even if its precise order of accuracy is unknown.

Another variation, again involving the meter, is the provision of an illuminated meter scale. Several meter manufacturers supply meter housings suitable for this facility, mainly for us with VU meters in which it is virtually standard. Such a refinement would be of most value in a darkroom, assuming that the meter illumination is "safe" in the same sense as the regular safelight.

In some cases this could be provided by substituting a suitably coloured glass for the normal meter glass, assuming that one feels confident to undertake cutting and fitting the glass. Alternatively, and particularly when the movement is housed in a transparent plastic case, it might be easier to fit coloured lamps.

In selecting any glass or lamps, beaware that the simple selection of colour does not automatically guarantee safety in the photographic sense. Glass which appears "red" or "green" may, in fact, only approximate the colour and be capable of transmitting colours to which the photographic material is sensitive. Any such improvised safelights should, therefore, be carefully tested before risking important material in their presence. ■

A Lab. Quality Regulated Supply

(From page 71)

incorrectly connected in series or parallel.

In a laboratory instrument as with all electronic equipment it is desirable to have a physical presentation which has the qualities of being both functional and aesthetically pleasing. As presented the present supply would appear to fulfil both these requirements quite well, with a minimum of complexity and cost.

In an effort to reduce the bench space occupied by the unit, we have used a metal case having the same dimensions as that used for our recent compact oscilloscopes, 7¼in x 5in and 8¼in deep. A 6in x 4in heat radiator, manufactured by Ferris Brothers, is attached to the rear of the case for the series regulator transistor. The case used for the prototype came from Heating Systems Pty. Ltd.

A small inverted-tray chassis is used to mount most of the components, being itself attached to the front panel using the output terminals, pilot lamp and power switch. The dimensions of the chassis are 1 3-16in x 4¼in x 8in.

The underchassis layout is fairly straightforward, with the components in the basic reference supply, including the zener diodes, being mounted on two 8-lug tagstrips. The two 2000uF electrolytic capacitors in the main doubler are mounted above the chassis, side-by-side and immediately in front of the power transformer.

The transformer terminations are made to the tag strip nearest the centre of the chassis, with the rectifier diodes for the main supply connected from the appropriate termination to the lugs on the can-mounting electrolytics.

A third tag strip of three lugs is used to retain the current sensing resistors. The remaining minor components are all mounted on miniature resistor panels. Two sections of panel are required, one being 13 lugs long and the other 8. As is shown in the under-chassis photograph, the Darlinton driver transistor is soldered directly to the smaller resistor panel using the extrusions provided on its heat radiator.

The remainder of the smaller resistor panel is reserved for the meter calibration resistors and the 0.68 ohm and 18 ohm cut-off-current range resistors. The large resistor panel is used to mount the components for the error and current-cut-off amplifiers.

The two transistors in the differential amplifier are fitted with small "flag" type heat radiators to maintain them both at approximately ambient temperature. The radiators are simply a precaution to obviate any temperature differential between the two, which would tend to upset voltage stability; they are not required for protection, as these devices operate at a low operating temperature.

The remaining aspects of the instrument assembly are fairly straightforward and should present few problems. A final point worth noting is that sufficient connection lead length (using heavier gauge wire) should be provided for the series regulator transistor, so that the chassis may be easily removed from the case. ■

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1968 ELECTRONICS Australia VTVM built one per cent resistors, $30. Ward, 94-2070, Syd.

TRANSFORMER. Auto. 230 volt 50Hz input. 4.8KW 16 position with underload switching from 57.5 to 228 volts. $40.00. Telfer, 69 Edgecumbe Street, Como, West Aust.

COMPONENT SPECIALS. 2in miniature transistor speakers, 8 ohm, $1.20 each. Transistor aerials, 4in extends to 28in, 85c each. OA80 diodes, 25c each. Kitsets, Aust., Box 176, P.O., Dee Why, N.S.W. 2099.

POLYPAC 64. Comprises 3 x 25VW electrolytics of the following values, 5uF, 10uF, 25uF, 50uF, 100uF, 200uF, 500uF, 1000uF. Total of 40 capacitors. Postage 15c. All new and top grade. Price $3.25. Kitsets Aust., Box 176, P.O., Dee Why, N.S.W. 2099.

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ADVERTISING INDEX

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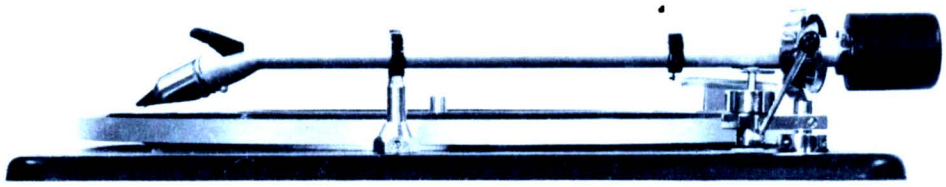

Perfection in a record player is now a reality and is available to you. If utmost clarity of reproduction and freedom from distortion is your main requirement choose a Labcraft Player. Various models and styles are available, all free from rumble, wow or flutter and fitted with magnetic stereo cartridges having extremely low distortion but reproducing the full audible sound spectrum.

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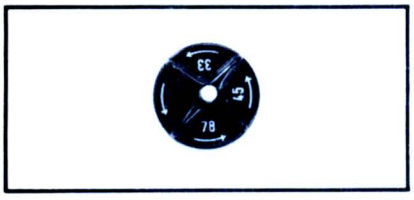
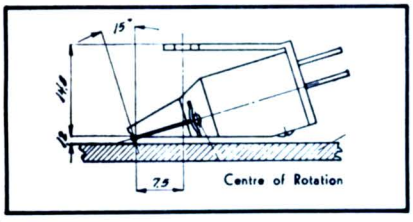
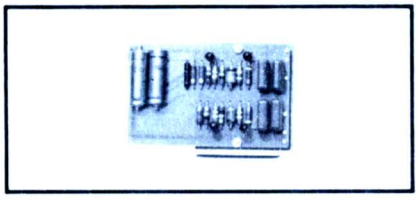


NO! You won't find an ordinary synchronous motor on a Labcraft Player. All Labcraft units have a specially designed SRT motor with variable speed control. Simply turn the central knob to raise or lower the speed by any desired amount; i.e. by up to ± 10% from any of the standard speeds of 33, 45, 78 rpm.

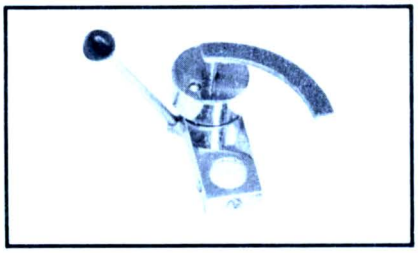


This cartridge should sound perfect!

A magnetic cartridge with elliptical diamond stylus set for 15° with a flat response from 20 Hz to 20 kHz, extremely low distortion and perfect square wave, outstandingly good shielding, the ideal tip mass of 1.5 mg. It does in fact sound perfect — it's the B & O SP 9! (SP 8 when fitted to the All Balance arm).



It doesn't matter if your power amplifier hasn't a pre-amplifier input section for magnetic cartridge. The Labcraft player takes the special low distortion, solid state pre-amplifier made by SRT of Copenhagen. Plugs in under the mounting board.



It's child's play (yes literally!) to lower the stylus down gently on the record with the oil damped 'pick up lift'. This is available for All Balance or B & O arms. It is an important contribution to record care besides making the player very easy to use.

Simple — natural — convenient is the unique SRT arm rest switch fitted to all Labcraft turntables or players. Just lift the arm and the motor starts. The switch has a capacitor to eliminate pops.

The base of the Labcraft Player has mitred corners as in the original Danish design. Choice of selected ash or teak or palisander. The smokey clear plastic cover looks magnificent and completes the picture.

Many details of design contribute to the perfection of Labcraft Players. For example:—lubricated in factory for years of playing, fully shielded motor, anti-vibration motor suspension, rim belt drive of special design, arm with in-built anti-skate, interchangeable cartridges, stylus pressure by special spring tension.

Ask your local Hi Fi dealer to obtain a Labcraft Stereo Record Player for you from the sole Australian Agents, **G.R.D. Instruments Pty. Ltd., of 6 Railway Walk, Camberwell, Victoria.** Telephone 82-1256.

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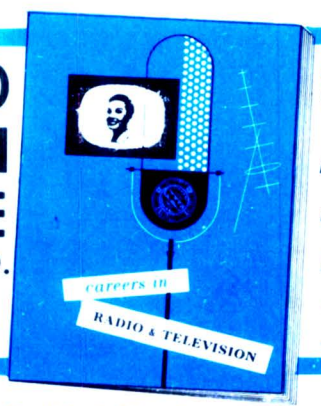

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